GROUND-WATER RESOURCES OF CAMBRIAN AND ORDOVICIAN CARBONATE ROCKS IN THE VALLEY AND RIDGE PHYSIOGRAPHIC PROVINCE OF PENNSYLVANIA

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CONTENTS

CONTENTS--Continued

Page

Hydrogeology--Continued

CONTENTS--Continued

ILLUSTRATIONS

Plates

[The plates are not included with this report but are on file in the U.S. Geological Survey, Pennsylvania District Library.]

Figures

ILLUSTRATIONS--Continued

TABLES

CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
inch (in.)	2.54	millimeter
foot (ft)	0.3048	meter
cubic feet (ft^3)	0.02832	cubic meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
million gallon per day (Mgal/d)	3,785	kiloliter per day
million gallon per day per square mile [(Mgal/d)/mi^2]	6,090	kiloliter per day per square kilometer
gallon per minute (gal/min)	0.06308	liter per second
gallon per minute per foot [(gal/min)/ft]	0.2070	liter per second per meter
gallons per day per square foot [(gal/day)/ft^2]	0.0407	liter per day per square meter
square foot per day (ft^2/d)	0.0929	square meters per day

Milligrams per liter (mg/L) is an expression of concentration that is equivalent to parts per million (ppm) and is equal to 1,000 micrograms per liter (μg/L).

Micrograms per liter is equivalent to parts per billion (ppb).

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ABSTRACT

Ground water is a vital resource for the 150,000 people living in 10 separate or contiguous valleys of Bedford, Blair, Centre, Clinton, Fulton, Huntingdon, and Mifflin Counties. These valleys have formed on anticlinal folds in a sequence of Cambrian and Ordovician carbonate strata that exceed 8,000 feet in thickness. Younger clastic strata conformably overlie the carbonate rocks and form ridges along the valley perimeters, which rise 700 to 1,500 feet above the valley floors.

About 43 Mgal/d (million gallons per day) of water is withdrawn for use in all the valleys; 90 percent is derived from ground-water sources. Nearly 75 percent of the water is used in the two largest valleys, 49 percent in the Nittany Valley, and another 25 percent in the Morrison Cove and Canoe Valleys.

Single wells can produce about 1,000 gal/min (gallons per minute) from the Gatesburg and Nittany Formations; 500 gal/min from the Bellefonte and Axemann Formations; at least 100 gal/min from the undivided Benner through Loysburg, undivided Coburn through Loysburg, undivided Bellefonte and Axemann, undivided Nittany and Larke, Warrior, and Stonehenge Formations; and 50 gallons per minute from the Rockdale Run, Shadygrove, and undivided Coburn through Nealmont Formations. Wells in valleys have the greatest potential yield and wells on hilltops the least. Other topographic positions have intermediate yield potentials. Ideally sited wells, such as those on fracture traces, have greater yields than do randomly sited wells. Local cave-passage orientation correlates with local joint orientation maxima, which correlates with local fracture-trace orientation. These relations can aid in the selection of sites for large production wells.

Recharge to the carbonate aquifers is from precipitation directly on the land surface and indirectly from runoff draining mountain slopes. In the latter case, about 80 percent of runoff from mountain slopes infiltrates the colluvium or enters sinkholes in stream channels along the valley perimeters. An estimated 75 percent of the runoff that infiltrates flows through conduits formed in the limestone immediately adjacent to the mountain flanks and discharges as springs a short distance downvalley. Discharges from these springs fluctuate greatly and some springs may be dry during periods of baseflow. Of 42 large perennial springs in the valleys, 26 have flows greater than 1,000 gal/min, and 3 have flows greater than 10,000 gal/min some of the time.

Annual precipitation in the Kishacoquillas and Spring Creek basins averages about 38 and 39 inches, respectively. About 21 inches is lost form each basin to evapotranspiration. Another 13 inches leaves the Kishacoquillas basin and 16 inches leaves the Spring Creek basin as ground-water discharge. The remaining water leaves as direct runoff. Water, in amounts equivalent to ground-water discharge, recharge the ground-water system and are available for use. Expressed volumetrically over the basin areas, 0.62 [(Mgal/d)/mi^2] (million gallons per day per square mile) is available for use in the Kishacoquillas basin and 0.80 [(Mgal/d)/mi^2] is available for use in the Spring Creek basin. During drought years, only 0.34 and 0.45 [(Mgal/d)/mi^2] are available in the Kishacoquillas and Spring Creek basins, respectively. The Sugar, Brush, Penns, and Big Cove Creek Valleys have similar hydrogeologic settings to the Kishacoquillas Creek basin; the Nittany, Morrison Cove, Canoe, and Snake Spring Valleys have similar hydrogeologic settings to the Spring Creek basin. Similar hydrogeologic settings will have similar amounts of ground water available for use.

Estimates of transmissivity, based on median specific capacity, range from 15 ft^2/d (feet squared per day) for the Coburn through Nealmont Formations to 5,200 ft^2/d for the Nittany Formation. Transmissivities determined from pumping test data range from 560 ft^2/d for the Benner through Loysburg Formations to 120,000 ft^2/d for the Nittany Formation. The specific yield of the carbonate rocks, based on water table declines during baseflow in the Kishacoquillas and Spring Creek basins, is 0.015. Interference is likely between pumped wells spaced as much as 1,000 feet apart and is greatest parallel to the dominant local fracture systems.

Ground-water quality is suitable for drinking and most other uses, but is hard. Iron and manganese concentrations slightly exceed the respective 0.3 and 0.5 milligram per liter, the U.S. Environmental Protection Agency maximum contaminant level (MCL) for potable water in less than 10 percent of the wells sampled. Nitrate concentrations exceed the MCL of 10 milligrams per liter (as nitrogen) in 17 of 146 wells sampled. Median concentrations of nitrate, as nitrogen, range from 3.3 milligrams per liter in the Northern Nittany and Penns, Sugar, and Brush Valleys to 5.9 milligrams per liter in the Kishacoquillas Valley. Herbicides at concentrations less than proposed MCLs, were found in 10 of 20 wells and springs sampled, but only in one sample at a greater concentration of 20 micrograms per liter.

Noticeable effects of withdrawals on water levels were noted in the vicinity of State College where an average of 8.1 Mgal/d is pumped from public supply wells and from quarries for purposes of dewatering. Although adequate amounts of potable water are available to meet current demands, monitoring of water levels is needed to manage over droughts.

The most widespread and growing water-quality problem is an increase in the amount of nitrate that enters the ground water from agricultural practices. A related potential problem results from the application of herbicides to farmland. At least nine sites that were contaminated by petroleum and other toxic chemical leaks and spills had been discovered, were undergoing cleanup, or were being monitored from 1983-86.

INTRODUCTION

Background

Ground water is vital to the residents of Pennsylvania. It is used for domestic, public, commercial, and industrial supply; and, in rural areas, is the only economical source available for water supply. Ground water also sustains streamflow during dry periods. A continuing cooperative program between the Pennsylvania Department of Environmental Resources (PaDER), Bureau of Topographic and Geologic Survey and the U.S. Geological Survey develops information that describes the ground-water resources of selected areas. The information gathered and interpreted is published in reports for use by state and municipal planners, consultants, and others interested in the quantity and quality of water in Pennsylvania.

Purpose and Scope

This report describes the occurrence, movement, quantity and availability, and quality of ground water in the Cambrian and Ordovician carbonate rocks of the Appalachian Mountain Section of the Valley and Ridge physiographic province. The study encompasses the 10 separate or contiguous valleys in 7 counties of central Pennsylvania (fig. 1).

The scope of work included original field inventory to establish a network of wells in which to make synchronous water-level measurements needed to prepare water-table maps, and in conjunction with existing stream gages, calculate aquifer storage and define water budgets. Well construction characteristics and yielding ability were determined from statistical analysis of data collected during this study and earlier studies (Taylor and others, 1982, 1985) (Wood, 1980) using the univariate procedure of the Statistical Analysis System (Council, K.A. 1979). Analyses by PaDER of about 150 water samples collected by U.S. Geological Survey personnel from selected wells and springs, provided data for determining the general ground-water quality and the extent of contamination, especially by nitrates. Some well inventory data and water-quality analyses from earlier reports are included in the data tables of this report and are used with new data for analysis and interpretation. Streamflow and water-level data were collected for Kishacoquillas and Spring Creeks and used with precipitation data from the U.S. Department of Commerce stations at State College, Milroy, and Lewistown for water budget and specific yield calculations.

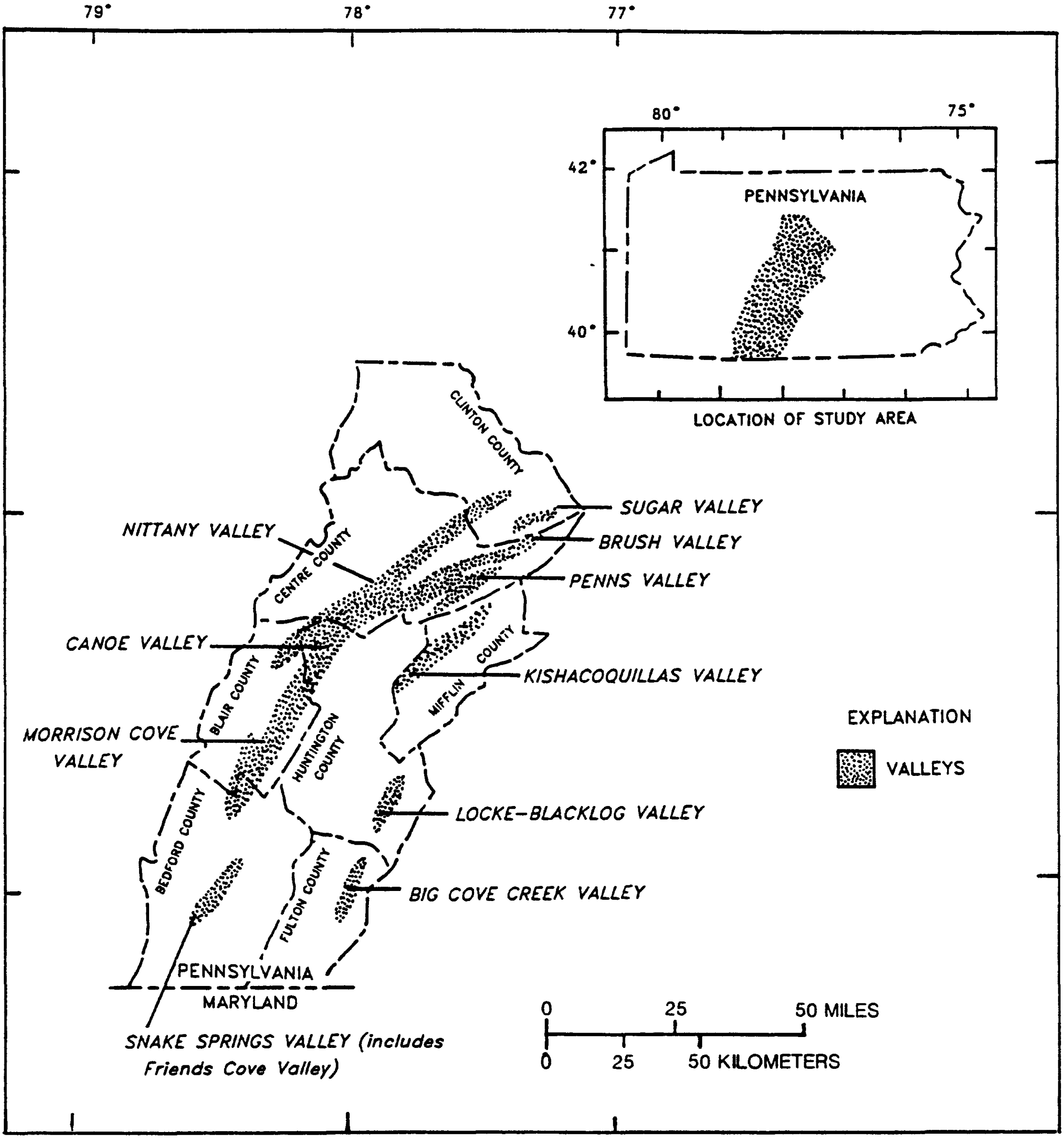

Figure 1.--Location of the valleys underlain by Cambrian and Ordovician carbonate valleys in south-central Pennsylvania.

Description of Study Area

Location and Physiographic Setting

The 10 valleys studied extend northeast, from the southern border of Pennsylvania, within the belt of alternating valleys and ridges that form the northern termination of the Appalachian Mountains (fig. 1). All of the valleys are elongate and range from about 15 mi (miles) (Locke-Blacklog Valley) to 60 mi (Nittany Valley) in length. The boundaries between named valleys that are connected are undefined and the names only reflect the geographic nomenclature of U.S. Geological Survey topographic quadrangle maps.

Steep, forested ridges reaching heights ranging from 700 ft to 1,500 ft (feet) above the valley floor, bound the valleys. Valley floors (feet) are ft above the valley floor, bound the valleys. Valley floors are undulating, in general, but broad, low ridges, underlain by a thick residuum, rise 300 to 500 ft in the middle of the westernmost valleys (Nittany, Snake Spring, Morrison Cove, and Canoe). Narrower dissected linear ridges, having 30 to 50 ft of relief, underlie the more weather-resistant dolomite formations in some valleys. The land surface area encompassed by all the valleys totals more than 700 mi^2 (square miles).

Geologic Setting

The valleys have developed on a folded sequence of Cambrian and Ordovician age limestone and dolomite formations that total over 8,000 ft in thickness. Shale of the Reedsville Formation stratigraphically overlies the carbonate rock sequence and generally crops out on the flanks of the adjacent quartzite and sandstone ridges, but is eroded from central parts of most valleys. These rocks were formed from sediments deposited under near-shore marine conditions over a 90 million year time span beginning about 520 million years ago.

Each valley occurs in the central part of an anticlinal fold that commonly is overturned slightly to the northwest. Smaller folds, thrust faults and extension faults modify the basic structural framework in parts of some valleys.

Population and Water Use

Between 1960 and 1980 the population of the valleys increased by an average of 29 percent and now totals more than 150,000 people. Although most of the population increase was in the vicinity of the Borough of State College in the Nittany Valley, the population in all other valleys also grew at rates ranging from 11 to 34 percent. Water use grew at least at these rates and probably at higher rates because of the general increase in per capita water use over this period of time.

Annual withdrawal of water from all ten valley averaged about 43 Mgal/d during recent years (T. Denslinger, Pennsylvania Department of Environmental Resources, written commun., 1985). More than 38 Mgal/d, or 90 percent, was derived from ground water sources. A summary of withdrawals by major water-use categories, excluding irrigation, is shown in figure 2. Withdrawals for irrigation are small, 0.3 Mgal/d, and are derived mostly from ponds and streams. Irrigation varies greatly from year to year depending on the amounts and timing of precipitation during the growing season and economic factors. Consumptive use in all categories is estimated at more than 8 Mgal/d.

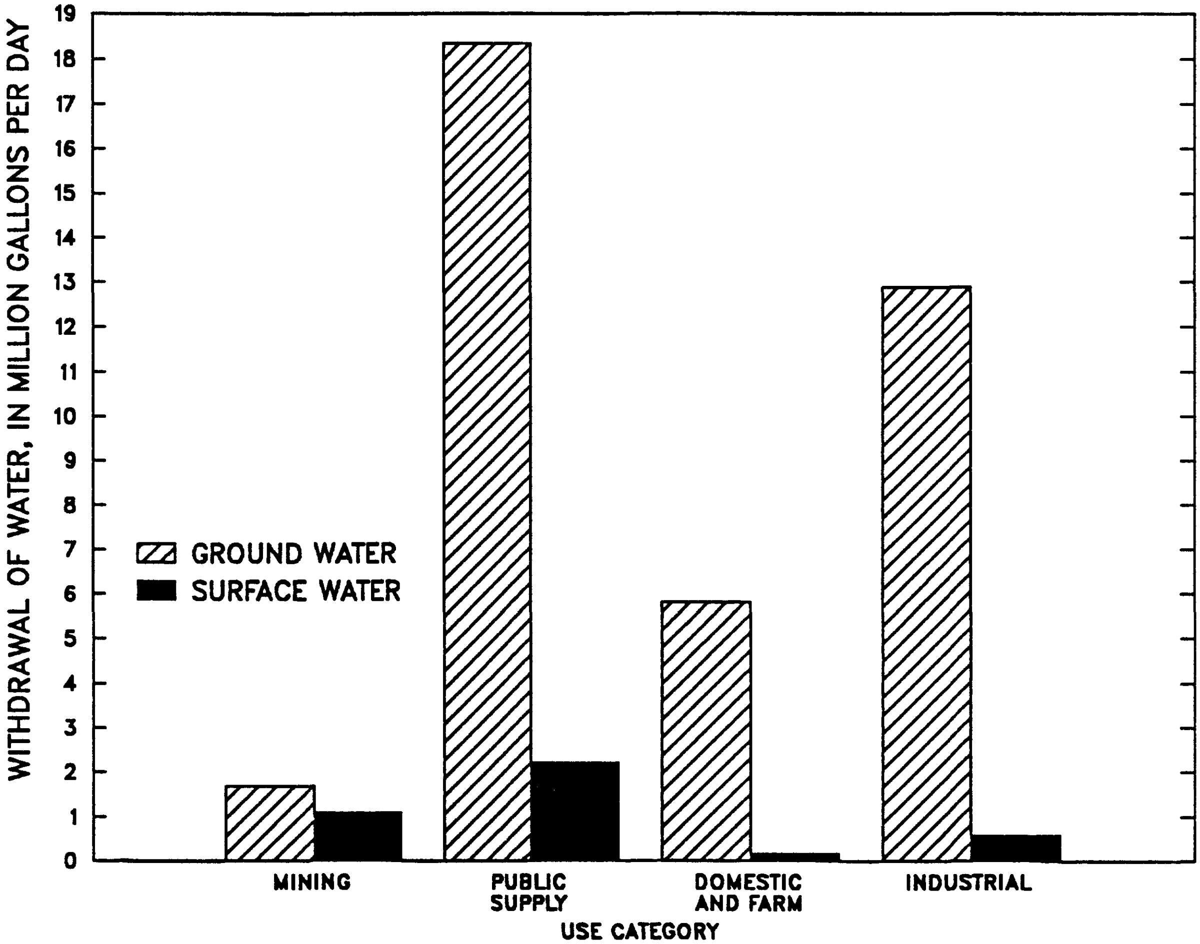

Figure 2.--Withdrawals of water by source and use category in the Cambrian and Ordovician carbonate valleys of south-central Pennsylvania.

Ground water withdrawal in each of the valleys is shown by use category in figure 3. Penns, Brush, and Sugar Valleys were combined because they have similar geology and land use and are connected geographically. In Locke-Blacklog Valley, less than 0.02 Mgal/d of water is withdrawn, all of it for domestic and farm purposes. Most of the water withdrawn is in the two largest valleys, 49 percent in the Nittany Valley and 25 percent in Morrison Cove and Canoe Valley.

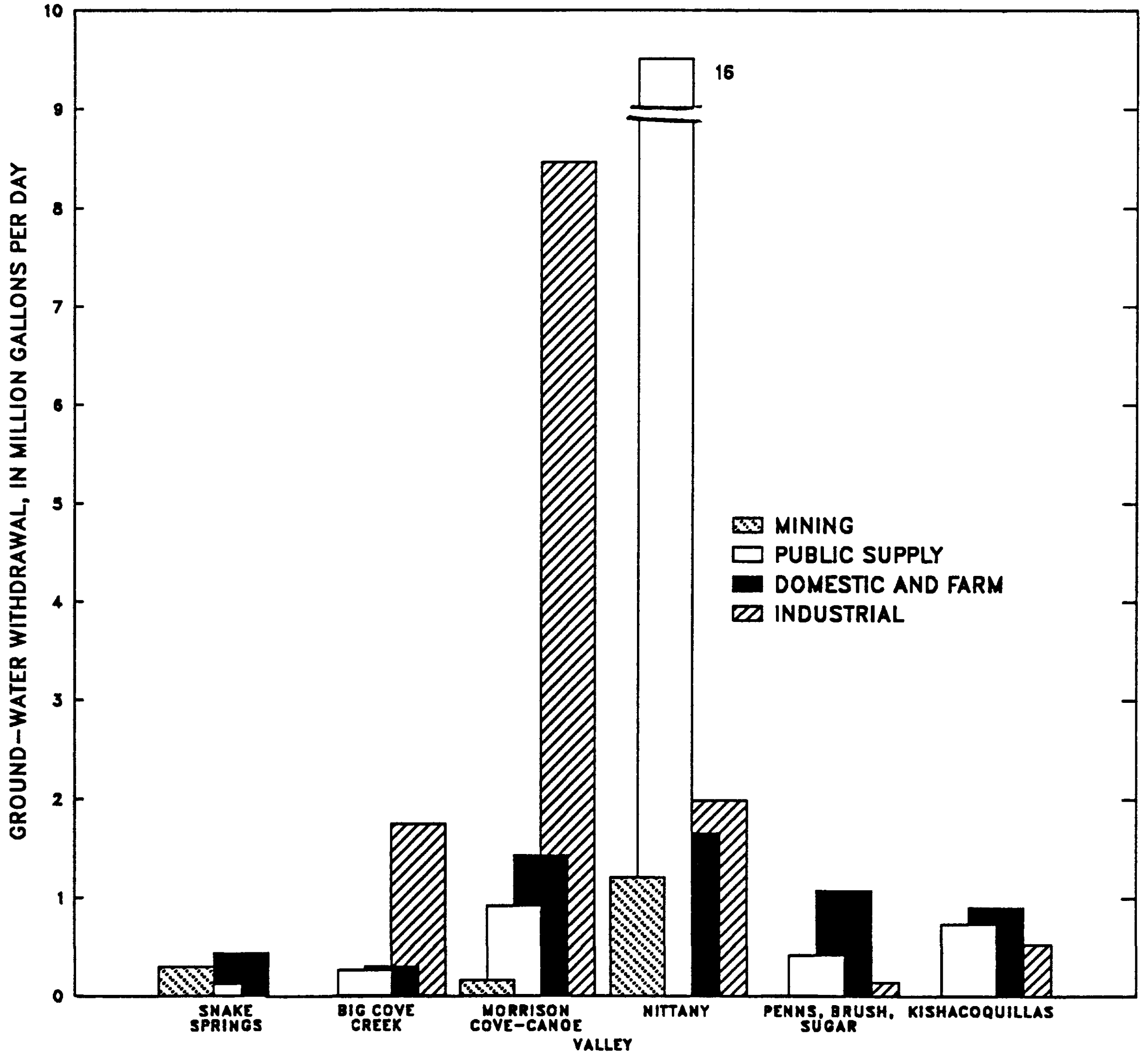

Figure 3.--Withdrawals of ground water by valley and use category.

Acknowledgments

The names of the many homeowners, organizations, institutions, municipalities, and companies who kindly allowed us access to their wells and property for the collection of the data essential to this study are given in the records of wells (table 1, at back of report) and springs (table 2, at back of report). We wish to offer special thanks to the Borough of Martinsburg and the Pennsylvania State University for their cooperation and help. John Kastrinos, while a graduate student at Pennsylvania State University, completed much of the well inventory in the Nittany, Penns, Brush, and Sugar Valleys. Information and reports provided by the Union Township Municipal Authority, Walker Township Water Association, Laurel Pipeline Company, Pennsylvania Electric Company, The Gulf Oil Company, Todd Giddings and Associates, Martin Associates, R.E. Wright Associates, and Moody and Associates were also helpful to the study. Edward Pinto, a graduate student at Shippensburg State University, compiled geologic information for the study, calculated the data on caves, and prepared many of the tables and illustrations in the report.

HYDROGEOLOGY

Stratigraphy and General Water-Bearing Properties of the Rocks

The stratigraphic sequence of geologic units discussed below and shown on the geologic maps (plates 1 and 2[1]) are based on the Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania (Berg and Dodge, 1981). Some of the geologic formations are grouped with other formations into one unit on the maps. The geology of each of these formations is described separately, but the water-bearing and water-quality properties are discussed for the combined unit unless the formation is mapped both separately and with other units on one or both geologic maps. Properties for the combined units then are discussed and, if the data permit, each formation also is discussed separately. The geologic units used in this report and how they are combined and shown on plates 1 and 2[1] for each valley are given in table 3. Actual stratigraphic relationships between geologic units are shown in the correlation of map units on plates 1 and 2[1].

Reedsville Formation

Description

The Reedsville Formation, the uppermost Ordovician unit, is a medium dark-gray to brownish- or greenish-gray shale with some interbedded siltstone and sandstone beds. Commonly the shale is fissile but may be thick bedded also. A black calcareous shale at the base of the formation grades into the underlying carbonate rocks and, where prominent, has been named the Antes Formation. This formation commonly crops out on the flanks of the ridges that border the carbonate-rock valleys.

Water-bearing properties

This formation was not a part of the study. However, data were obtained on 28 wells inventoried for water levels. The median specific capacity and reported yield are 0.4 [(gal/min)/ft] of drawdown and 20 gal/min, respectively.

Water quality

No samples were collected for chemical analysis from the Reedsville Formation for this study. However, recent analytical results from several other studies (Taylor and others, 1982, 1983) indicate the water is moderately hard to hard with low to moderate dissolved solids content. Excessive amounts of iron, manganese, and hydrogen sulfide are common.

Summary evaluation

Low-production uses are readily supplied by shallow wells in the Reedsville Formation.

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[1] Plates are on file in the U.S. Geological Survey, Pennsylvania District Library.

Table 3.--Stratigraphy and distribution of mapped geologic units in valleys (Arrows extend across more than one formation where the included formations are mapped as one unit.)

VALLEYS GEOLOGIC FORMATIONS	Sugar	Brush	Penns	Nittany (North end)	Nittany (Middle)	Nittany (South end-East side)	Nittany (South end-West side)	Kishacoquillas	Morrison Cove and Canoe	Snake Springs	Big Cove Creek	Locke-Blacklog
Reedsville	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕
Coburn	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Salona	│	│	│	│	│	│	│	│	│	│	│	│
Nealmont	↓	↓	↓	↓	↓	│	│	↓	│	│	│	↓
Benner	↑	↑	↑	↑	↑	│	│	↑	│	│	│	
Snyder	│	│	│	│	│	│	│	│	│	│	│	
Hatter	│	│	│	│	│	│	│	│	│	│	│	
Loysburg	↓	↓	↓	↓	↓	↓	↓	↓	↓	│	↓	
Bellefonte	↕		↕	↕	↕	↑	↕	↑	↑	↓	↕	
Axemann			↕	↕	↕	↓	↕	↓	↓	↕		
Rockdale Run											↕	
Nittany				↕	↕	↑	↑		↑	↑	↑	
Larke						↓	↓		↓	↓	↓	
Stonehenge				↕	↕							
Shady Grove											↕	
Gatesburg				↑	↑	↑	↑		↑	↑		
Mines Member				│	↓	│	↓		│	│		
Lower Members				↓	↕	↓	↕		↓	↓		
Warrior					↕	↕	↕		↕	↕		
Pleasant Hill						↕			↕			
Waynesboro									↕			

Coburn, Salona, and Nealmont Formations, Undivided

Description

The Coburn Formation is a medium and medium- to very dark-gray, thin-bedded, argillaceous, and fossiliferous limestone containing interbeds of calcareous shale. It attains a maximum thickness of 325 ft at Bellefonte in the Nittany Valley.

The Salona Formation is a very dark-gray to black, medium- to coarse-grained, sparsely fossiliferous limestone with some shale partings. It is about 170 ft thick.

A 30- to 75-ft thick medium- to dark-gray unit called the Nealmont Formation underlies the Salona. It consists of the Rodman and Centre Hall members. The Rodman, the upper member, is medium- to dark-gray, coarsely crystalline, and contains abundant crinoid and bryozoan fossils. The Centre Hall is medium- to dark-gray and finely crystalline limestone. A break in deposition occurred between deposition of the Nealmont Formation and the underlying Benner Formation. These formations commonly outcrop adjacent to the noncarbonate rocks on the ridge flanks.

Water-bearing properties

Unbuffered, slightly acidic runoff from the mountain ridges commonly reaches the outcrop area of these thin formations before any other carbonate rocks in the valleys. Therefore, these formations have the greatest potential for solution of carbonate minerals. Major contrasts between lithologies in adjacent beds of these formations cause differences in their relative solubilities (Rauch, 1972). Sinkholes, large conduit passages, and caves are well developed in the more soluble beds. Most runoff from the mountains drains into sinkholes, flows through conduits, and discharges within hours or days to streams (Konikow, 1969). Once conduit passages exist they are the preferred paths of flow and further enlargement rather than small fractures. The openings available to most wells, however, are small fractures and solution openings that have retained recharge in storage for much longer periods.

The median specific capacities of wells constructed for low-production uses (29 wells) and for high-production uses (4 wells) are 0.08 [(gal/min)/ft] and 0.12 [(gal/min)/ft], respectively. The median reported yields for 55 wells of low-production use and 11 wells developed for high-production use are 10 gal/min and 12 gal/min, respectively. A maximum yield of 90 gal/min and a maximum specific capacity of 2 [(gal/min)/ft] were determined from the well data for these formations. About 25 percent of all wells in these formations yield 5 gal/min or less. Variability in the well yield and specific capacity statistics among different valleys is negligible. Five of the 42 large springs shown in the record of springs (table 2) yield from these formations.

Water quality

Water from these formations is hard to very hard (median hardness 205 mg/L as $CaCO_3$). The median of specific conductance measurements of well water is 520 µS/cm (microsiemens per centimeter at 25 degrees Celsius) and the median pH measurement is 7.3.

Summary evaluation

These formations can supply adequate amounts of water for low-production use. Development of supplies of water for high-production use is possible from some springs and from wells that intercept large conduits below the zone of water-table fluctuation. The water will likely be hard.

Benner, Snyder, Hatter, and Loysburg Formations, Undivided

Description

The Benner Formation consists of light- to dark-gray, mostly fissile to flaggy and thick-bedded, very-finely to finely crystalline limestone. Two members are recognized in the Benner--the high calcium limestone Valentine Member, at the top, and the underlying argillaceous Valley View Member that contains interbedded metabentonite beds. The combined thickness of these members is about 150 ft.

Below and in gradational contact with the Benner is the Snyder Formation, an 80-ft thick, medium- to dark-gray, coarsely crystalline limestone and limestone conglomerate containing interbeds of finely crystalline dolomitic limestone. Laminated, mud-cracked and ripplemarked beds commonly are present.

The Hatter Formation underlies the Snyder. It is a medium- to dark-gray, fine-grained, argillaceous, laminated, dolomitic and oolitic limestone that is about 75 ft thick. The Hatter unconformably overlies the underlying Loysburg Formation.

The Loysburg Formation consists of light- to medium-gray, medium- to thick-bedded, fine-grained, shaly limestone in the upper Clover Member and dark gray dolomite and dolomitic limestone in the lower Milroy Member. Both members vary in thickness but have an average combined thickness of about 150 ft.

Water-bearing properties

Hydrogeologic conditions in these formations are similar to those in the overlying Coburn, Salona, and Nealmont Formations with one exception. These formations crop out in more central parts of the valley, especially in Penns, Sugar, and Brush Valleys. Inflow from the adjacent ridges, therefore, is not channeled directly into large conduits, and recharge spreads more evenly through the existing fracture openings. A comparison of the specific capacities and reported yields shown below with those shown for the overlying units clearly shows the importance of this hydrogeologic difference.

The median specific capacity for 15 low-production-use wells is 0.33 [(gal/min)/ft] and for 4 high-production-use wells is 17 [(gal/min)/ft]. Median reported yields of 36 low-production-use and 9 high-production-use wells are 22 and 60 gal/min, respectively. The maximum well yield reported is 350 gal/min. About 10 percent of the wells yield 5 gal/min or less. Four large springs of the 42 listed in the Record of Springs (table 2) discharge from these formations.

Water quality

Water is hard to very hard (median hardness 205 mg/L as $CaCO_3$). The median specific conductance is 565 μS/cm and the median pH is 7.3. Iron and manganese in three of 21 wells sampled exceeded the secondary maximum contaminant level (SMCL) recommended by the U.S. Environmental Protection Agency (USEPA) (1986b) of 300 μg/L (micrograms per liter) for iron and 50 μg/L for manganese. Concentrations in two samples exceeded the MCL for nitrate (U.S. Environmental Protection Agency, 1986a) of 10 mg/L and the SMCL of 500 mg/L for total dissolved solids (U.S. Environmental Protection Agency, 1986b).

Summary evaluation

Supplies of hard water are readily available for low-production use from wells in these formations. Supplies for high-production use are available from some springs and from wells that intercept cavity systems below the zone of water-table fluctuation.

Coburn through Loysburg Formations, Undivided

Description

Formations in the stratigraphic interval between the top of the Coburn and the base of the Loysburg Formations are mapped as one unit in the southern part of the Nittany Valley and in all the valleys farther to the south. Lithologic characteristics are similar to the equivalent units described.

Water-bearing properties

Statistical values of the water-bearing properties for the undivided rocks, fall between the upper and lower statistical values of the separate rock units, as would be expected. For low-production uses, the median specific capacity of 16 wells and median reported yield of 43 wells are 0.17 [(gal/min)/ft] and 8 gal/min, respectively. The median reported yield of six high-production-wells is 30 gal/min. The maximum specific capacity measured is 2.3 [(gal/min)/ft] and the maximum yield reported is 100 gal/min. One of the large springs listed in table 2 discharges from this geologic unit.

Water quality

Water from this stratigraphic interval is hard to very hard. A median hardness of 188 mg/L was determined for water from these rocks. The median pH and specific conductance of well water are 7.3 and 460 µS/cm, respectively. One of the 10 samples analyzed exceeded the USEPA's SMCL for dissolved solids. Another sample exceeded the SMCL for iron, and two others exceeded the SMCL for nitrate.

Summary Evaluation

Yields of up to 100 gal/min of hard water are obtained from wells in these formations. Large solution cavity systems below the zone of water-table fluctuation, if intercepted by a well, could provide high-production-use supplies.

Bellefonte Formation

Description

The upper Tea Creek Member of the Bellefonte Formation is light- to medium-gray, very fine-grained dolomite. Medium-gray dolomite of the lower Coffee Run Member also contains sandstone beds and chert. The combined thickness of both members is about 1,400 ft.

Water-bearing properties

The median and maximum specific capacities of 32 low-production-use wells in the Bellefonte Formation are 0.20 and 17 [(gal/min)/ft], respectively. Similarly, the median and maximum reported yields for 77 low-production-use wells are 12 and 120 gal/min. For high-production-use wells, the median specific capacity for 11 wells is 0.46 [(gal/min)/ft] and the maximum specific capacity is 20 [(gal/min)/ft]. The median and maximum reported yields for high-production-use wells are 26 and 500 gal/min, respectively. About 15 percent of all wells have yields reported to be less than 5 gal/min. Eleven of the 42 large springs shown in table 2 discharge from the Bellefonte Formation.

Water quality

Water from the Bellefonte Formation is very hard. The median values of hardness, pH, and specific conductance are 239 mg/L as $CaCO_3$, 7.3, and 570 µS/cm, respectively. Three of 33 wells exceed the SMCL for iron, one of 30 for manganese, and five of 33 exceed the MCL for nitrate.

Summary evaluation

Yields in excess of 500 gal/min of potable water are possible from wells located at the most favorable sites in the Bellefonte Formation.

Axemann Formation

Description

Light- to dark-gray, coarsely crystalline, fossiliferous limestone interbedded with silty, fine-grained limestone and silty, fine-grained dolomitic limestone characterize the Axemann Formation. Chert concretions and oolitic, conglomeratic limestone are also present. The Axemann averages about 500 ft in thickness but ranges from 400 to 700 ft.

Water-bearing properties

The median and maximum specific capacities for data from seven low-production-use wells in the Axemann Formation are 0.93 and 16 [(gal/min)/ft]. The median reported yield for 16 low-production-use wells is 20 gal/min. The maximum reported well yield is 700 gal/min from a high-production-use well. Only one of 18 wells is reported to yield less than 5 gal/min.

Water quality

Water from wells in the Axemann Formation is very hard (median hardness, 257 mg/L as $CaCO_3$). The median pH and specific conductance of water from wells in this formation are 7.5 and 619 μS/cm, respectively.

Summary evaluation

Large supplies of very hard water can be obtained from favorably located wells in the Axemann Formation. A residential supply probably can be developed from any randomly located well.

Bellefonte, Axemann Formations, Undivided

Description

The Bellefonte and Axemann Formations are mapped as one unit in the Morrison Cove, Canoe, and Kishacoquillas Valleys, and in the southeastern end of the Nittany Valley. Descriptions of rocks are the same as for the separate formations.

Water-bearing properties

The median and maximum specific capacities of 14 low-production-use wells are 0.25 and 5.6 [(gal/min)/ft], respectively. The median and maximum reported yields for 45 low-production-use wells are 10 and 150 gal/min, respectively. About 25 percent of all wells yield less than 5 gal/min. Five of the 42 large springs listed in table 2 yield from this geologic unit.

Water quality

Water from all wells is very hard. The calculated median values of hardness, pH, and specific conductance are 239 mg/L as $CaCO_3$, 7.2, and 605 µS/cm, respectively. Iron in water from one of 11 wells and manganese in water from one of 9 wells exceed the USEPA's SMCL.

Summary evaluation

Most wells provide adequate supplies of water for residential and other low-production-uses. Wells at favorable sites will yield 50 gal/min and may yield more than 500 gal/min. Water is very hard.

Rockdale Run, Nittany, Nittany and Larke, and Stonehenge Formations

The Rockdale Run is the lateral equivalent of the lower part of the Bellefonte Formation and the Nittany and Axemann Formations in Big Cove Creek Valley. The Larke Formation is the lateral equivalent of the Stonehenge Formation, and is mapped with the overlying Nittany Formation to the south and west in the southern part of the Nittany Valley, the Snake Spring Valley, Morrison Cove and Canoe Valleys, and Big Cove Creek Valley.

Rockdale Run Formation

Description

Rocks of the Rockdale Run Formation are mostly light- to medium-gray, laminated, fine-grained limestone with some beds of dolomite near the top that contain small white chert rosettes. The lower part of the formation contains abundant brown, chert-bearing dolomite beds.

Water-bearing properties

Information is available from only two wells in this formation. Reported yields and specific capacities of these wells are 16 and 40 gal/min and 0.4 and 0.44 [(gal/min)/ft], respectively. Data from 41 wells in the Rockdale Run Formation in adjacent Franklin County have a median specific capacity of 0.6 [(gal/min)/ft]. About 25 percent of these wells yield less than 5 gal/min.

Water quality

No water-quality information is available for this formation in the study area. In Franklin County, the water from this formation is very hard.

Summary evaluation

The Rockdale Run Formation should supply at least 50 gal/min of hard water to wells.

Nittany Formation

Description

The Nittany Formation is composed of finely to coarsely crystalline, alternating light- and dark-gray beds of dolomite that contains siliceous oolites and some sandy and cherty beds. The Nittany is about 1,200 ft thick.

Water-bearing properties

The median and maximum specific capacities of seven low-production-use wells in the Nittany are 0.6 and 160 [(gal/min)/ft], respectively. For 20 high-production-use wells, the median and maximum specific capacities are 33 and 600 [(gal/min)/ft], respectively. Eight of the 22 reported yields for high-production-use wells in the formation exceed 1,000 gal/min. The median and maximum yields for the 22 high-production-use wells are 537 gal/min and 2,200 gal/min, respectively. About 15 percent of all wells yield less than 5 gal/min. Four of the 42 large springs listed in table 2 discharge from the Nittany Formation.

Water quality

The median pH, specific conductance, and hardness of water from wells are 7.4, 610 µS/cm, and 211 mg/L as $CaCO_3$, respectively. Water from the Nittany Formation ranges from hard to very hard. Water analyzed from one of the ten wells sampled exceeds the USEPA's MCL for nitrate and the SMCL for total dissolved solids.

Summary evaluation

Yields in excess of 1,000 gal/min are obtained from wells that intercept large openings of interconnected fracture systems. Very hard, potable water is available from the Nittany Formation.

Nittany and Larke Formations, Undivided

Description

The Nittany Formation has been described previously. The Larke Formation is a dark-gray, coarsely crystalline dolomite containing fine-grained, laminated dolomite in the lower part, and some thick beds of fine-grained limestone. It is the stratigraphic equivalent of the Stonehenge Formation and is mapped with dolomites of the Nittany Formation in the Snake Spring, Morrison Cove and Canoe Valleys, and the southern tip of the Nittany Valley (Wagner, p. 19; Butts, 1939). The Larke Formation is about 250 ft thick.

Water-bearing properties

The median and maximum specific capacities of 35 low-production-use wells in these combined formations are 0.27 and 74 [(gal/min)/ft], respectively. Similarly, the median and maximum reported yields of 81 low-production-use wells are 10 and 200 gal/min, respectively. The reported yields of the two high-production-use wells are both 150 gal/min. For about 20 percent of the wells, reported yields are less than 5 gal/min.

Water quality

Well water has a median hardness of 214 mg/L, as $CaCO_3$, and is very hard. A median pH of 7.3 and a median specific conductance of 492 µS/cm was calculated for well water in this unit. Iron and dissolved solids concentrations in water from 2 of 17 wells and manganese concentrations in water from 5 of 14 wells exceed the USEPA's SMCLs for these constituents. Concentrations of these constituents in water from 3 of 17 wells exceed the MCL for nitrate.

Summary evaluation

Some wells yield more than 100 gal/min. Specific-capacity data suggest a few wells in very favorable locations can supply more than 1,000 gal/min. Water from most wells is very hard.

Stonehenge Formation

Description

The Stonehenge Formation is a medium- and dark-gray, finely crystalline limestone that contains thin laminae, bands, or up to 6-foot thick interbeds of dolomite. Thin, flat pebble conglomerate and flaggy beds characterize the lower part of the formation and chert nodules are present near the base. The thickness of this formation ranges from 250 to 600 ft.

Water-bearing properties

A median of 30 gal/min was calculated from reported yield data for 11 low-production-use wells. The maximum well yield reported is 100 gal/min. All well yields reported exceed 5 gal/min. Specific capacities of 0.39, 0.49 and 3.9 [(gal/min)/ft] were determined for the three wells.

Water quality

Water from the Stonehenge Formation is hard to very hard (median hardness 171 mg/L as $CaCO_3$), has a median specific conductance of 339 μS/cm, and a median pH of 7.5.

Summary evaluation

Most wells can supply adequate quantities of water for residential and other low-production-uses. Wells in favorable locations typically yield more than 100 gal/min.

Shadygrove and Gatesburg Formations

The Shadygrove Formation in Big Cove Creek Valley is the lateral equivalent of the Mines Member of the Gatesburg Formation (Berg and others, 1983). Pierce (1966, p.6), in the McConnelsburg quadrangle, mapped these rocks as the upper part of the Conococheague Group. Root (1968) mapped 650 ft of rocks as the Shadygrove Formation in southeastern Franklin County. Clark (1970) recognized a thinner sequence as Shadygrove in western Franklin County but did not give it formation status.

The Gatesburg is the uppermost formation of Cambrian age and consists of five members. In descending order, these are the Mines, upper sandstone, Ore Hill, lower sandstone, and Stacy Members. Only the Mines Member is mapped separately in parts of the Nittany Valley. Here, the remaining four members are grouped as one unit and informally called the "lower members." Each of the lower members was defined by Butts (1918, p. 527).

Shadygrove Formation

Description

The Shadygrove Formation consists of medium-gray, fine-grained, banded limestone containing minor amounts of edgewise conglomerate, oolites, and crossbedded sandstone. Pink and light-gray marbleloid limestones are prominent near the top of the formation. Sandy, light-colored chert blocks are present in the soil residue.

Water-bearing properties

Yields reported for two wells in the Shadygrove are 30 and 50 gal/min. The only specific capacity is 2 [(gal/min)/ft]. Slightly lower values of specific capacity (median 1.3 [(gal/min)/ft]) and well yield (median 18 gal/min) were obtained by Becher and Taylor (1982) in Franklin County.

Water quality

Data are available from only one well. Water from this well is very hard (190 mg/L as $CaCO_3$).

Summary evaluation

Yields of 50 gal/min of potable water can be expected from wells in the Shadygrove Formation.

Gatesburg Formation, Undivided

Description

The description of the rocks is a composite of those for the individual members, discussed later.

Water-bearing properties

Specific capacities for six high-production-use wells in the Gatesburg Formation have median and maximum values of 8.6 and 30 [(gal/min)/ft], respectively. The median and maximum yields reported for eight high-production-use wells are 165 and 300 gal/min, respectively. For low-production-use wells, the median reported yield of 54 wells is 10 gal/min and the median specific capacity for 19 wells is 0.10 [(gal/min)/ft]. About 20 percent of all wells have reported yields that are less than 5 gal/min.

Water quality

The median values of pH, specific conductance, and hardness are 7.5, 355 µS/cm, and 154 mg/L as $CaCO_3$, respectively. The water ranges from soft (17 mg/L as $CaCO_3$) to very hard (290 mg/L as $CaCO_3$). Water from one of the 18 wells sampled exceeded the USEPA's SMCL for iron.

Summary evaluation

Wells commonly yield 100 gal/min, but yields in excess of 500 gal/min can be obtained. Although the water is hard, water quality is excellent .

Mines Member of Gatesburg Formation

Description

The Mines Member is mostly a dark-gray, coarse-grained dolomite. Landon (1963) measured the thickness as 230 ft in the Bellefonte quadrangle but reported 150 ft further south. Weathering of this member leaves a clay soil containing abundant oolitic chert composed of little black spherules in a lighter colored groundmass.

Water-bearing properties

The clay soil overlying the Mines Member causes water to pond at the surface; at depth, it produces a discontinuous shallow perched water-table system that may be more than 100 ft above the main ground-water system in the Nittany Valley. The specific capacities of two low-production-use wells in the Mines Member are 2.3 and 9.4, and for the one high-production-use well, 380 [(gal/min)/ft]. The median yield reported for six low-production-use wells is 60 gal/min and the maximum yield reported is 8,000 gal/min. One half of the 14 yields reported are for wells drilled for high-production-use. No well yield of less than 30 gal/min is reported from this member.

Water quality

Water ranges in hardness from soft to very hard (34 to 310 mg/L as $CaCO_3$). The median pH, hardness, and specific conductance are 7.6, 137 mg/L as $CaCO_3$, and 360 µS/cm, respectively. Concentrations in water from one of the three wells sampled exceed the USEPA's SMCL for iron and the MCL for nitrate.

Summary evaluation

Wells in the Mines Member can supply potable water for high-production needs in excess of 1,000 gal/min.

Lower Members of Gatesburg Formation

Description

The upper and lower sandstone members have essentially the same lithology. They are composed of dark-gray, thin-bedded, microcrystalline, silty dolomite, that weathers buff-colored; thin-bedded, finely crystalline, shaly dolomite; and coarse-grained quartzose sandstone beds that grade, in ascending order, from conglomerate to sandstone. A 40-ft zone of interbedded limestone and sandstone is present in the upper sandstone. Each of the sandstone members is about 600 ft thick. Between the sandstone members is the Ore Hill Member, a dark-gray, massively bedded, coarsely crystalline dolomite that is between 130 and 310 ft thick. South of Williamsburg this member grades to thin bedded limestone (Landon, 1963). The Stacy Member is a dark-gray medium and coarsely crystalline dolomite interbedded with oolitic and cryptozoan-bearing dolomite. This member is present only in the Snake Spring (Knowles, 1966), Morrison Cove, and Canoe Valleys (Butts, 1945) and is defined as the rocks between the sandstone float of the lower sandstone member and the limestone of the underlying Warrior Formation. Partly as a result of this definition, the Stacy Member is variable in both occurrence and thickness. It is not reported in the Nittany Valley (Wood, 1980) but 68 ft were measured in Snake Spring Valley (Knowles, 1966), and about 500 ft is reported by Butts (1945) in Morrison Cove and Canoe Valley.

Water-bearing properties

A residual clay soil has formed over the Ore Hill Member and commonly results in ponding of water and a perched water-table, similar to that in the Mines Member. Water levels in wells Ce 408 and 409, 800 ft apart, show this condition; these wells are 325 ft and 65 ft deep, respectively. The altitude of water levels in the respective wells is 1,070 and 1,300 ft. Sandier soils overlying the other members of the Gatesburg Formation allow the rapid passage of infiltrating water.

The median and maximum specific capacities of 17 high-production-use wells are 21 and 380 [(gal/min)/ft], respectively. For the same use category, the median and maximum reported yields of 18 wells are 467 and 8,000 gal/min, respectively. The medians of 7 specific capacities and 14 reported yields of low-production-use wells are 15 [(gal/min)/ft] and 60 gal/min. All wells yield more than 5 gal/min.

Water quality

Water is moderately hard to hard (median hardness 120 mg/L as $CaCO_3$), has a median pH of 7.6, and a median specific conductance of 344 μS/cm. One of the four water samples analyzed contained iron in excess of USEPA's SMCL.

Summary evaluation

Wells in the lower members of the Gatesburg Formation can be expected to provide large supplies of moderately hard water for high-production uses. Yields of more than 1,000 gal/min can be obtained.

Warrior Formation

Description

Butts (1918, p. 528) described the Warrior Formation in the Snake Spring Valley. It is also exposed in the Morrison Cove and Canoe Valley (Butts, 1945) and the Nittany Valley (Wilson, 1952). The upper part of the Warrior Formation is dark-gray, mostly limestone with interbedded dolomite, and the lower part is mostly dolomite with some interbedded limestone. Stromatolitic and oolitic beds and interbeds of sandstone or shale are also present. The thickness of this formation is 1,250 ft, as measured by Butts (1945) at Williamsburg in the Canoe Valley, and 1,350 ft, as measured by Wilson (1952) at Warriors Mark Creek in the Nittany Valley.

Water-bearing properties

The median and maximum specific capacities of 13 low-production wells are 0.85 and 2 [(gal/min)/ft], respectively. The median and maximum of 19 well yields reported are 17 and 150 gal/min, respectively. About 10 percent of all wells have reported yields of less than 5 gal/min.

Water quality

The median values of pH, specific conductance, and hardness, in the same order, are 7.3, 503 μS/cm, and 171 mg/L as $CaCO_3$, respectively. Water ranges from moderately hard (100 mg/L as $CaCO_3$) to very hard (380 mg/L as $CaCO_3$).

Summary evaluation

Almost all wells in the Warrior Formation will yield adequate supplies of good quality water for low-production uses. Well yields of 50 gal/min or more are common.

Pleasant Hill and Waynesboro Formations

Description

The Pleasant Hill Formation is exposed only in small areas of three fault blocks: one in the Nittany Valley, another in the Canoe Valley, and the third in Morrison Cove. The upper 200 ft of this formation is a dark-gray, fine-grained limestone containing fossiliferous, oolitic, and conglomerate layers (Butts, 1945). The lower 400 ft is micaceous and weathered outcrops yield shale debris.

The Waynesboro contains greenish-gray and grayish-purple shale, sandstone, quartzite, and conglomerate. Because only part of it is exposed in one small area in Morrison Cove, its total thickness is not known, but it exceeds 200 ft.

Summary evaluation

No well or spring data are available for these formations.

Occurrence and Movement of Water

Water enters each of the valleys as streamflow, runoff from adjacent ridges, and precipitation. It leaves as water vapor through evaporation and plant transpiration, streamflow, and infiltration into the soil followed by percolation into the ground-water reservoir; most ground water ultimately discharges to streams.

Surface Drainage

Many small streams drain the valleys. Cove Creek, in the Snake Spring Valley, discharges into the Raystown Branch Juniata River, and Clover Creek, in the Morrison Cove and Canoe Valley, enters the Frankstown Branch of the Juniata River. The Sugar, Brush, and Penns Valleys are drained by Fishing, Elk, and Penns Creeks, respectively. Fishing Creek drains to the north into the West Branch Susquehanna River. Penns Creek receives the drainage from the westward flowing Elk Creek and flows east, eventually discharging into the Susquehanna River. The Nittany Valley is drained by Spruce Creek in the south, Spring Creek in the center, and Little Fishing Creek in the north. Spruce Creek flows southward into the Raystown Branch Juniata River; Spring Creek and Little Fishing Creek flow northwestward into Bald Eagle Creek, and their combined flow eventually reaches the West Branch Susquehanna River. Kishacoquillas Creek drains the Kishacoquillas Valley and flows southward to the Juniata River. Blacklog Creek drains Locke-Blacklog Valley to the west and its waters eventually flow northward into the Juniata River. Big Cove Creek, in the valley of the same name, also drains to the west, but its water flows southward and discharges through the Potomac River basin.

Flow System in the Carbonate Rocks

Ground-water recharge

The carbonate aquifer is recharged from precipitation directly by infiltration and indirectly by infiltration of the surface runoff from adjacent mountains. Direct recharge occurs almost everywhere in the carbonate valleys. Recharge is greatest during the period from about October through April each year when temperatures are lowest and vegetation is dormant. However, recharge of the carbonate aquifer occurs at any time of year from a steady soaking rain.

The recharge process is complex inasmuch as percolation rates vary and arrival in the main ground-water body may lag precipitation by hours, days, months, or perhaps even years. Soil thickness, texture, composition, inhomogeneity, and moisture content control percolation to the main ground-water reservoir. Clay in soils formed over the argillaceous limestone of the Coburn through Loysburg Formations locally retards downward movement. Water that enters the soil can move laterally and downgradient for long distances before entering the main ground-water reservoir. Meiser and Earl (1977) describe a three-part ground-water system in the soil overburden and rock of these limestone formations northeast of State College near Nittany Mountain. They report a "near-surface soil system, an intermediate-level saturated bedrock water table, and a deep conduit underdrain system. These systems must be imperfectly interconnected* * *the surface system must leak through the soil to some extent to provide recharge to the bedrock water table; and the saturated bedding planes and fractures of the intermediate system leak slowly, because of the poor degree of their interconnection, to the conduit* * *." Some recharge must enter all three systems as water levels rise quickly in each following precipitation.

Direct recharge to the main body of ground water in the Gatesburg Formation may be delayed for months. The hydrograph of well Ce 118 (fig. 4) in the Gatesburg Formation of the Nittany Valley shows only a seasonal rise and fall with a lag time of several months. Individual storms do not cause rises in water level, and dry periods do not cause declines in water level as can be seen in the hydrograph for well Ce 636 (fig. 5) in Penns Valley. Instead, some water is perched above the Gatesburg Formation in local ground-water systems near land surface and in nearby ponds. Residual clay, probably from the Mines and Ore Hill Members (Landon, 1963, p. 62), thick overburden (commonly 100 to 200 ft) and the deep water levels (commonly exceeding 200 ft) are the main causes for the delayed recharge. A lag of 1 year in recharge to the Gatesburg Formation is reported by Giddings (1974, p. 30) for 1967, following a 7-year period of drought.

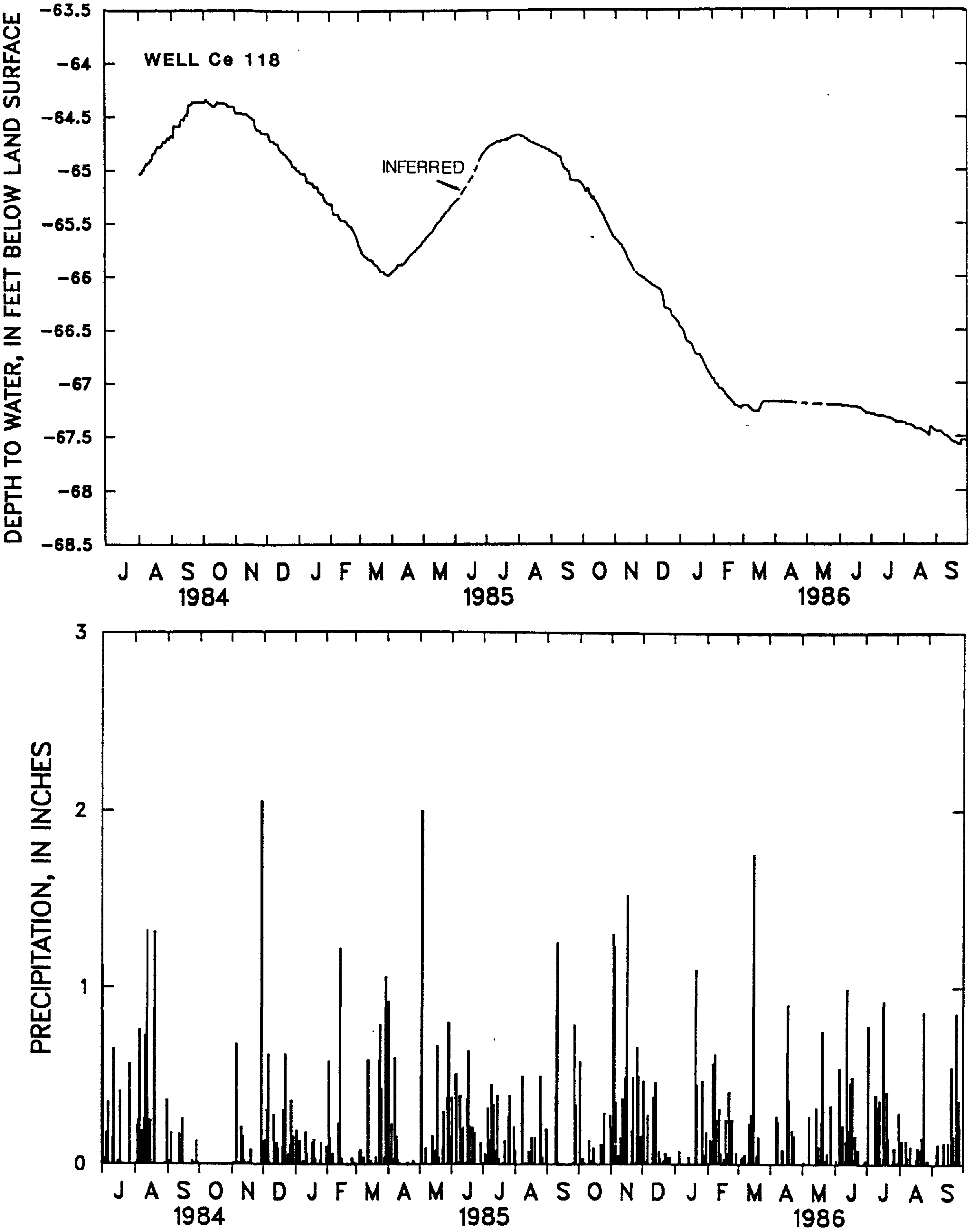

Figure 4.–Hydrograph of well Ce 118 in the Gatesburg Formation and daily precipitation at State College, Pennsylvania.

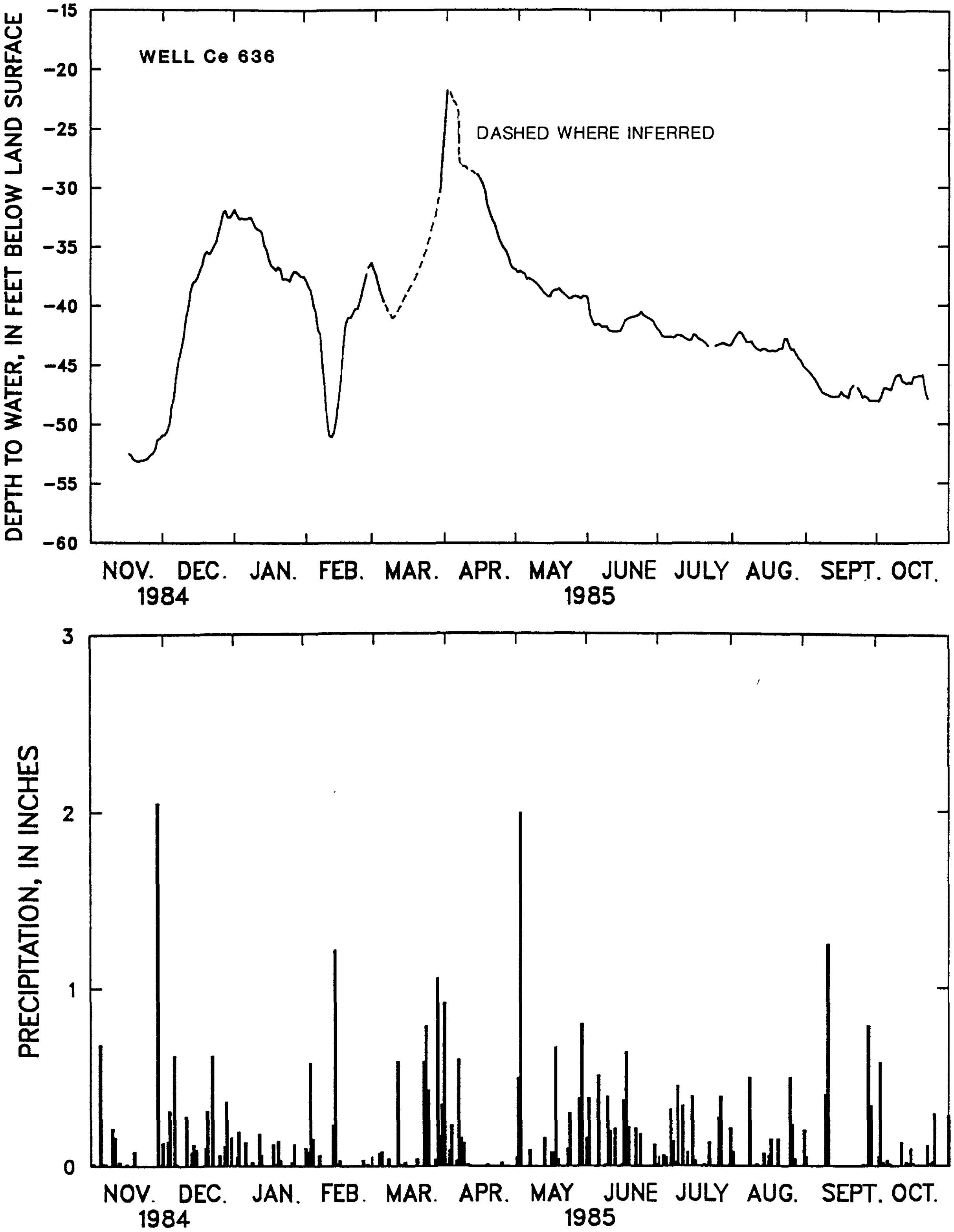

Figure 5.--Hydrograph of well Ce 636 in the undivided Coburn through Nealmont Formations and daily precipitation at State College, Pennsylvania.

Water infiltrating the colluvium on the flanks of mountain ridges, either directly from precipitation or through stream channels, is an important source of recharge to the carbonate-rock aquifers in the adjacent valleys. Konikow (1969, p. 111) calculated that 80 percent of this water enters the carbonate-rock aquifers in the Nittany Valley, but only 25 percent actually increased ground-water storage. Most water from mountain streams that enters the carbonate aquifer returns to the surface, usually only a short distance down the valley, through springs fed by conduits in the limestone formations immediately adjacent to the mountain flanks. Discharge from these springs may be large, exceeding 10,000 gal/min, in response to precipitation and snowmelt, but baseflows commonly are an order of magnitude lower and can be zero.

Water levels

Water levels rise as net storage increases in response to recharge and fall as net storage decreases in response to discharge from the aquifer, either by natural processes or by pumping. The hydrographs of wells reflect changes in aquifer storage. Seasonal changes are shown most clearly by figures 6 and 7, the hydrographs of wells Bd 508 and Ce 580 in Snake Spring and Nittany Valleys, respectively. The boreholes of these wells do not intercept percolating water directly. Therefore, only the widely distributed effects of recharge from individual rainfalls appear in the hydrograph.

Contours of the potentiometric surface, based on water-level measurements made in a network of about 500 wells, are shown on plates 1 and 2[2]. Water-level measurements were made in May 1984, for wells in the Kishacoquillas and Snake Spring Valleys; in April through June of 1984, for wells in Morrison Cove and Canoe Valley; in April and May of 1985, for wells in the Sugar, Brush, Penns, and Nittany Valleys; in June and July of 1985, for wells in Big Cove Creek Valley; and in July 1986, for wells in Locke-Blacklog Valley.

The potentiometric contours show that ground water tends to flow from the mountains toward the valley centers and then laterally down the valley. Although movement tends to be toward the valley centers, much of the conduit flow is parallel to the valley trend, even along the valley sides.

Water-level measurements also were obtained for the network wells in the fall of the same year the spring measurements were made in all but Big Cove Creek and Locke-Blacklog Valleys.

Statistical comparison of the changes in water level from spring to fall, by geologic unit, shows that the water levels decline least in the Gatesburg Formation; the average decline is 2.2 ft, excluding the maximum and minimum 10 percent of the changes. The upper and lower 10 percent of the data was excluded to eliminate major affects from a few large or small changes in water level on the data. Seasonal declines in the Gatesburg are greatest in the Nittany Valley (averaging 2.9 ft) where withdrawals also are greatest. Maximum declines in water level were in the Bellefonte Formation of Penns and Sugar Valleys. The decline averaged 21 ft, excluding the maximum and minimum 10 percent of the changes. Average seasonal declines for all valleys and rock units was 9 ft.

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[2] Plates are on file in the U.S. Geological Survey, Pennsylvania District Library.

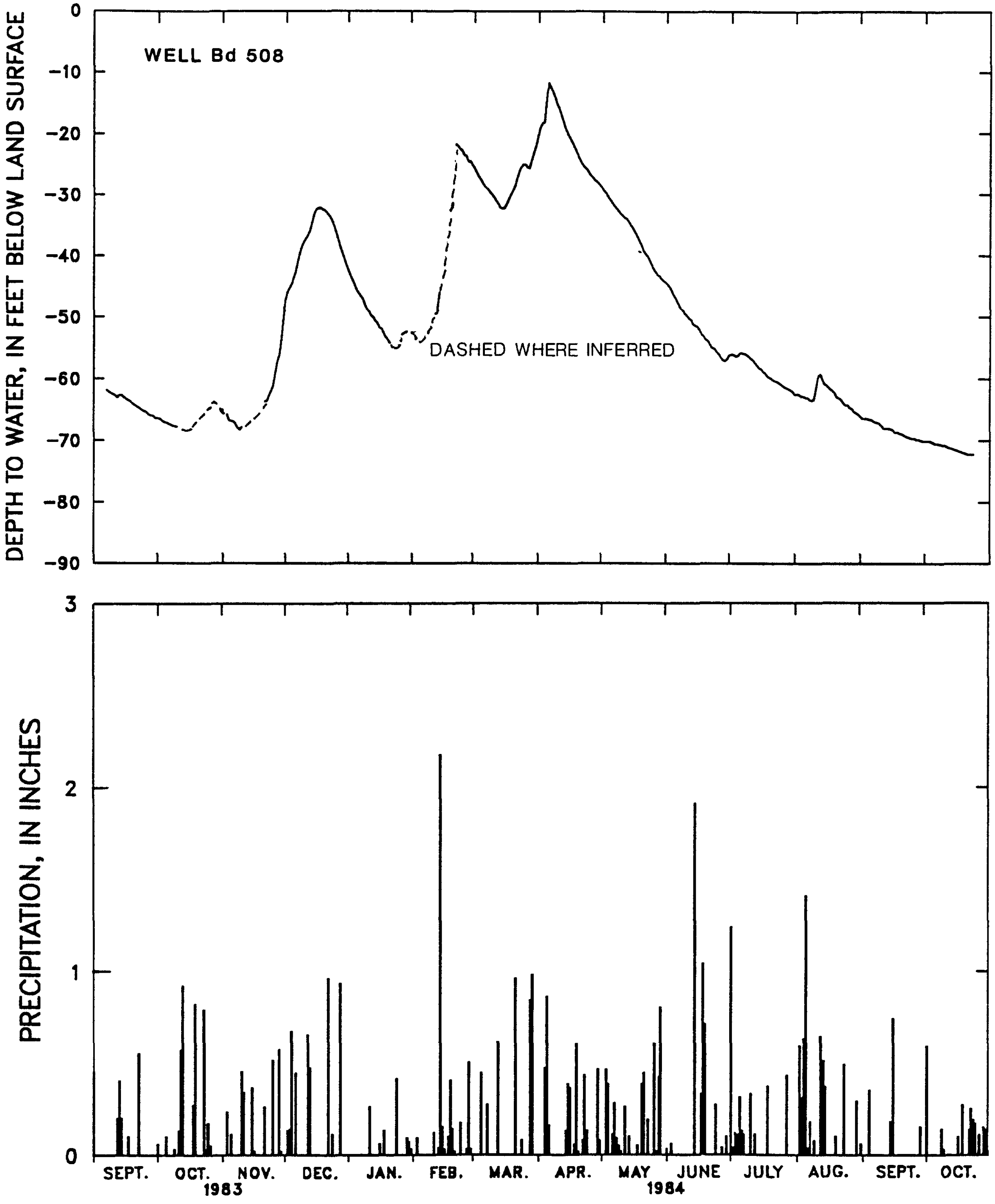


Figure 6.--Hydrograph of well Bd 508 in the undivided Nittany and Larke Formations and daily precipitation at Martinsburg, Pennsylvania.

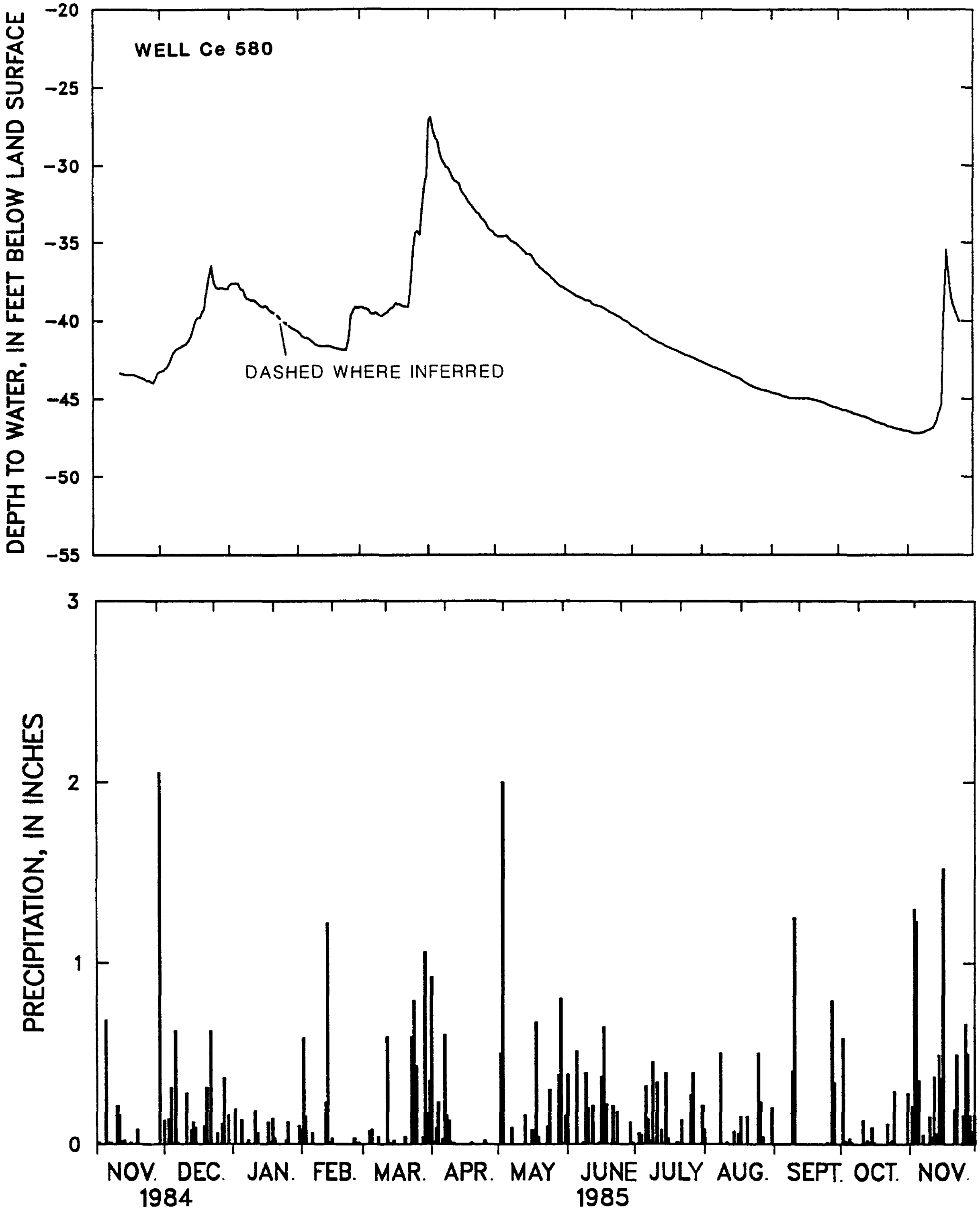


Figure 7.--Hydrograph of well Ce 580 in the Gatesburg Formation and daily percipitation at State College, Pennsylvania.

Relation between ground water and surface water

Within the valleys, ground water discharges through many large and small springs. Commonly, water re-enters the ground-water reservoir through permeable sediments in stream beds or swallow holes (fig. 8). Studies by Landon (1963), Konikow (1969), and Krothe (1976) discuss the gaining and losing character of streams in the Nittany Valley. Moorshead (1975) documented infiltration rates on several streams in the Nittany Valley. His estimates range from 10 to 150 [(gal/day)/ft²] (gallons per day per square foot). He reported a median infiltration rate of 25 [(gal/day)/ft²].

Figure 8.--Upstream view of Sinking Run about 1,500 feet downstream from Arch Spring in the Nittany Valley showing where water sinks into stream bed.

Springs

All recharge is discharged eventually from the aquifers through springs that range in flow from a few gallons per day to measured volumes in excess of 14,000 gal/min (table 2). The average annual discharge of all springs in a ground-water basin is a good estimate of recharge and therefore a measure of the supply of water available for consumptive use.

Water Budget

A water budget is a quantitative expression of the balance between the major components of water moving in and out of an area. It is a measure of the total water resource available under natural conditions. A simplified equation of this balance that assumes no inflow enters the system from across ground-water divides is:

$$P = Rs + Rg + \Delta S + ET \qquad (1)$$

where P = precipitation,
Rs = the surface-runoff component of total streamflow,
Rg = the ground-water-discharge component of total streamflow (base flow),
ΔS = change in ground-water storage, and
ET = water loss (chiefly evaporation and transpiration).

Water budgets were developed for two of the ground-water basins in the study area. Each selected basin has a long streamflow record and is representative of one of the two hydrogeologic basin types prevalent in the carbonate valleys. The Spring Creek ground-water basin contains a central area underlain by interbeds of carbonate-cemented sandstone and sandy dolomite of Cambrian age, including the Gatesburg Formation, that is characteristic of all the western-most carbonate valleys. The Kishacoquillas Creek ground-water basin and the remaining carbonate valleys, with the exception of Big Cove Creek Valley, expose only Ordovician age carbonates, largely interbedded limestone and shaly limestone. The sandy Cambrian age rocks that lie deep beneath younger carbonates have not been tested but probably store little, if any, usable fresh water.

Table 4 shows the average annual water budgets for the Kishacoquillas Creek for water years 1941-70 and for Spring Creek for 1968-83. Data for long, equivalent periods of time were not available for these stations. Water budgets are also shown for the 1984 and 1985 water years in both basins.

Table 4.--Water budgets for representative ground-water basins
[All values are in inches unless stated otherwise;
--, no data]

Water year(s)	Precipitation[1] (P)	Surface runoff (Rs)	Ground-water discharge (Rg)	Water losses (ET)
		Spring Creek at Milesburg		
1968-83 (average)	39.30	2.23	16.54	20.53
Percent of precipitation	--	6	42	52
1984	46.07	3.62	20.20	22.25
Percent of precipitation	--	8	44	48
1985	35.38	1.10	16.35	17.93
Percent of precipitation	--	3	46	51
		Kishacoquillas Creek at Reedsville		
1941-70 (average)	38.17	3.95	12.98	21.24
Percent of precipitation	--	10	34	56
1984	52.90	7.80	17.28	27.82
Percent of precipitation	--	15	33	52
1985	40.50	2.62	12.18	25.70
Percent of precipitation	--	7	30	63

[1] Precipitation for Spring Creek is at State College (precipitation for April and September 1984, and April and May 1985 is at Tyrone). Precipitation for Kishacoquillas Creek is at Milroy (precipitation for water years 1941-43, 1951, and some months in 1945 and 1952 is at Lewistown).

Precipitation

Records of the U.S. Weather Bureau stations at Milroy and Lewistown provided precipitation (P in equation 1) data for the Kishacoquillas ground-water basin and from the stations at State College and Tyrone for the Spring Creek ground-water basin. Records from Lewistown and Tyrone were used to provide data during periods of missing data at Milroy and State College.

Precipitation varies monthly, seasonally, and annually, as well as geographically. Figures 9 and 10 illustrate the temporal variability. These two bar graphs compare the geographic variability of precipitation between stations that are less than 20 mi apart. Long term average monthly precipitation shown on the graphs indicates that each of the summer months of May through August average about 25 percent more precipitation than the other months of the year. Summer precipitation is also the most variable geographically, because most of it comes from local showers and thunderstorms rather than the regional storm patterns prevalent at other times of the year.

Precipitation averaged 38.17 in. in the Kishacoquillas basin for the 30-year period from 1941-70 and 39.30 in. in the Spring Creek basin for the 16-year period from 1968-83. A comparison of these averages with precipitation in 1984 and 1985 indicates that, in 1984, precipitation exceeded the average by 39 percent in the Kishacoquillas Valley and 17 percent in the Spring Creek basin. For 1985, precipitation was 6 percent above average in the Kishacoquillas basin and 11 percent below average in the Spring Creek basin.

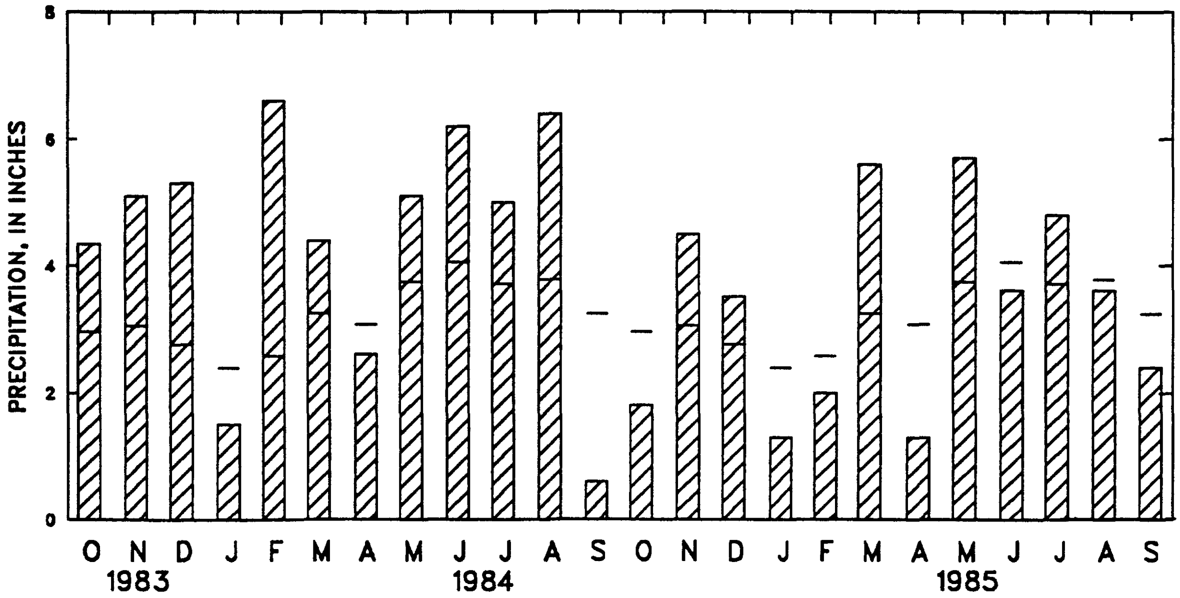


Figure 9.--Monthly precipitation during water years 1984-85 at Milroy, Pennsylvania and average monthly precipitation from 1941-70.

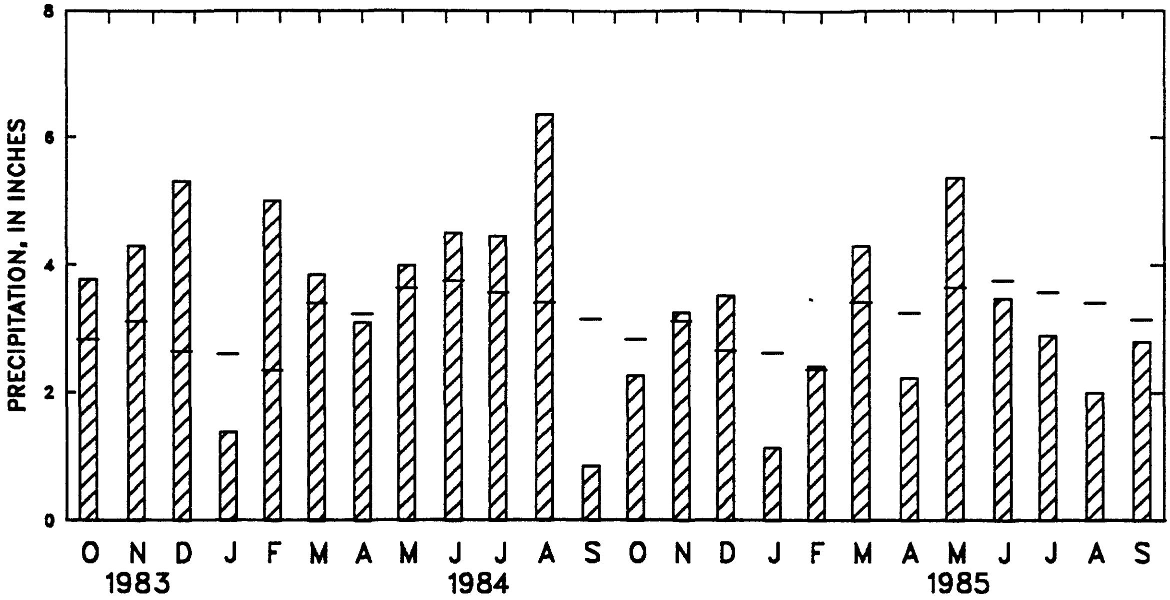


Figure 10.--Monthly precipitation during water years 1984-85 at State College, Pennsylvania and average monthly precipitation from 1968-83.

Streamflow

Streamflow (Rg + Rs in equation 1) was obtained from records of the U.S. Geological Survey for gaging stations on Kishacoquillas Creek at Reedsville (1941-70, 1984, 1985) and Spring Creek at Milesburg (1968-85). Between 1970 and 1984, the Reedsville station was not active, and the Milesburg station was not established until 1968. The average annual streamflow for Kishacoquillas Creek and Spring Creek are 6.454×10^9 ft^3 (cubic feet) and 7.371×10^9 ft^3, respectively. These discharges are equivalent to 16.93 in. and 18.77 in. spread across the respective basins.

Ground-Water Discharge

The importance of ground-water input (base flow or Rg in equation 1) to total streamflow is shown by the hydrographs in figures 11 and 12. In summer and fall, streamflow is maintained almost entirely by ground-water discharge. Only in winter and spring is direct runoff a significant part of streamflow.

Base flow was separated from total flow using the "Fixed Interval Method" developed for computer analysis of daily streamflow by Pettyjohn and Henning (1979). Ground-water discharge and base flow are considered to be equivalent terms since little, if any, water can bypass the gaging stations.

Ground-water discharge averaged 4.946×10^9 ft^3 annually from the Kishacoquillas Creek basin and 6.57×10^9 ft^3 from the Spring Creek basin. These discharges are equivalent to 12.98 and 16.54 in. spread over the respective ground-water basins. Ground-water discharge accounts for about 34 and 42 percent of precipitation in the Kishacoquillas and Spring Creek basins, respectively.

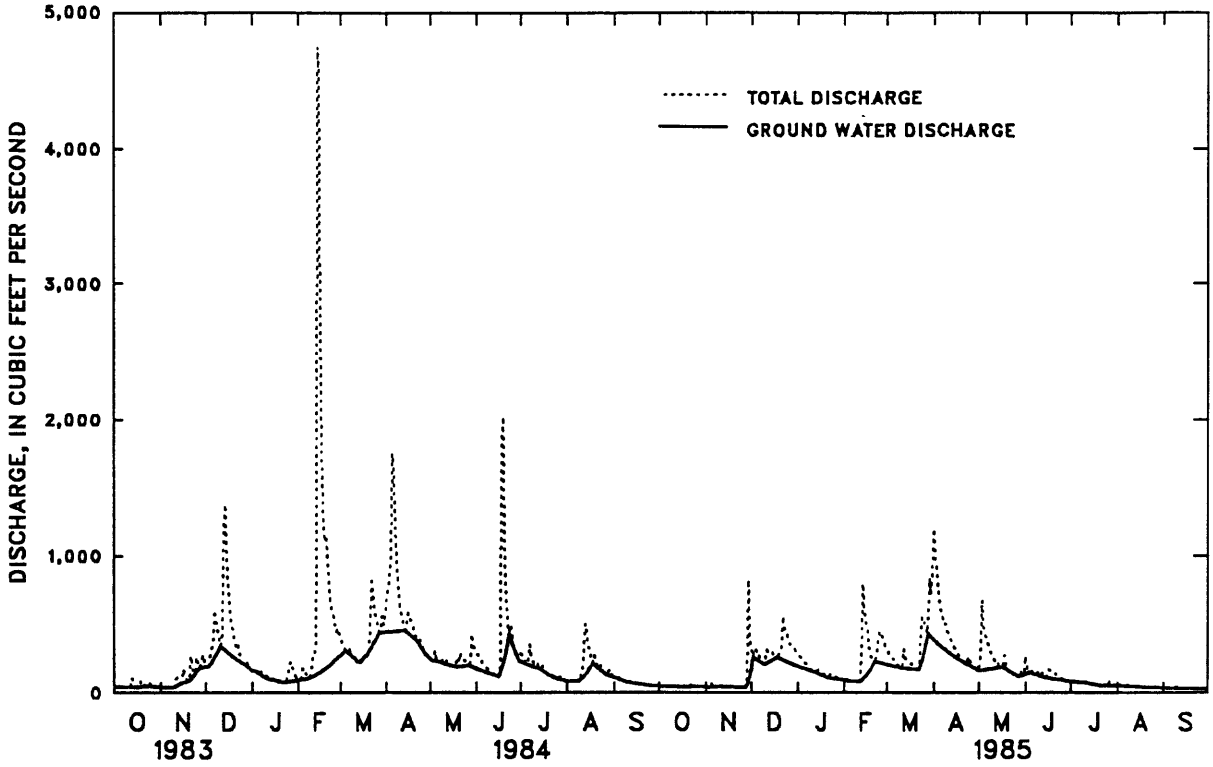


Figure.11.--Discharge of Kishacoquillas Creek at Reedsville, Pennsylvania, water year 1984-85.

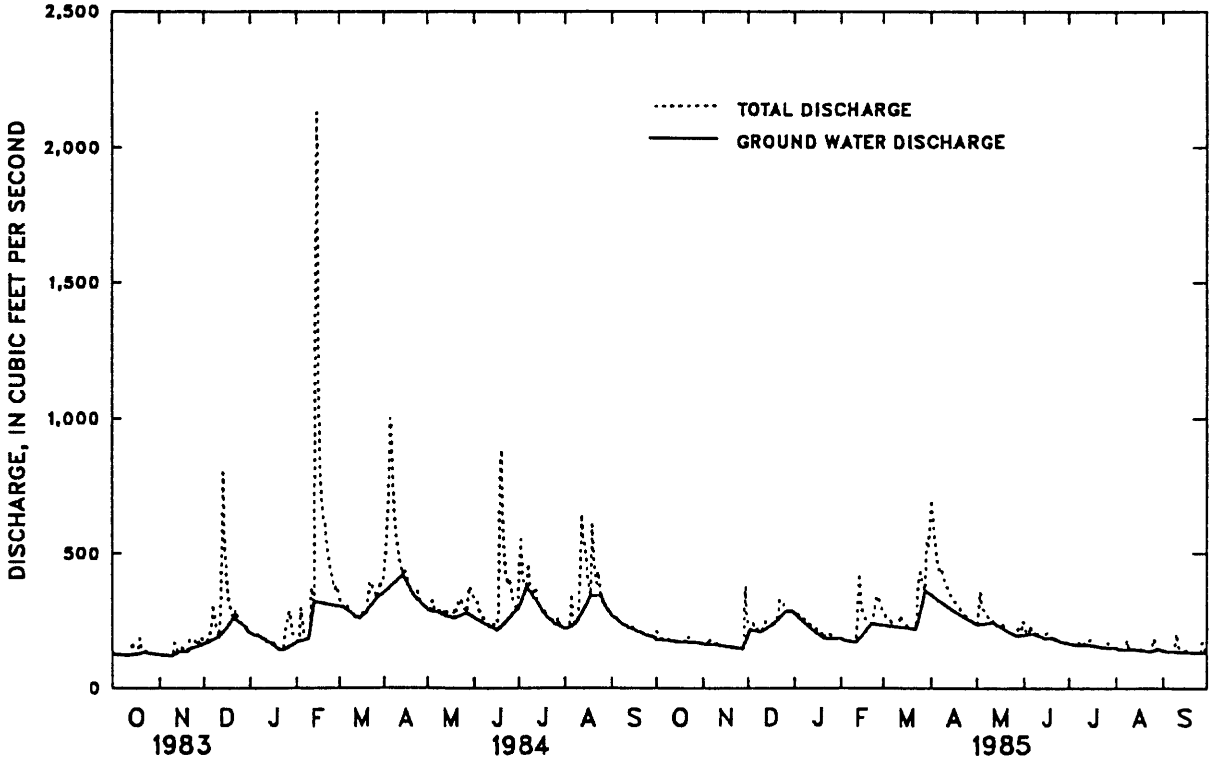


Figure 12.--Discharge of Spring Creek at Milesburg, Pennsylvania, water year 1984-85.

Surface Runoff

Surface runoff (Rs in equation 1) was computed as the difference between total streamflow and ground-water discharge. Runoff averaged 1.508 × 10^9 ft^3 from the Kishacoquillas Creek basin and 0.881 × 10^9 ft^3 from the Spring Creek basin. These amounts are equivalent to 3.95 and 2.23 in. spread over the respective ground-water basins.

Evapotranspiration

Water lost to the atmosphere by evaporation from surface bodies of water, wetted surfaces, moist soil, and by transpiration of plants constitute the largest output component in the water budget. Evapotranspiration (ET in equation 1) losses decline rapidly in early fall as plant growth stops and temperatures decrease. Through late fall and winter, ET is negligible, but in early spring it increases rapidly and reaches a maximum in summer. Commonly, recharge to the ground-water system and streamflow are greatest when ET is least and least when ET is greatest.

ET was calculated in the budget as the difference between precipitation and total streamflow. The average annual loss to ET is 21.24 in. from the Kishacoquillas basin and 20.53 in. from the Spring Creek basin. These losses constitute 56 percent and 52 percent of average annual precipitation in the respective basins.

Ground-Water Storage

Normally, changes in ground-water storage (ΔS in equation 1) are large from season to season but are negligible when averaged over periods of many years. Similarly, the amount of soil moisture stored in the unsaturated zone above the water table may vary by several inches from season to season or from year to year but when averaged over periods of many years is not a significant amount. Therefore, in the long-term budget analysis in table 4, ground-water storage changes are assumed to be zero. In other words, recharge equals discharge over the long term.

A small net change in ground-water and soil-moisture storage are believed to have occurred during the project in the 2-year period between October 1983 and September 1985. Base flow at the beginning of water year 1984 was nearly the same as at the end of water year 1985 in both basins and was the total flow both of these times. Precipitation in late September 1985 was sufficient at both Lewistown and State College stations to cause some additions to soil moisture content. Although the hydrographs of wells Mf 344 and Mf 367, in the Kishacoquillas Valley (fig. 13), did not show any residual additions to storage from the precipitation, ground-water levels were slightly higher at the end of the 2-year period than at the beginning. Most of the precipitation was lost to ET, based on the effects shown in stream and well hydrographs. Net changes to ground-water storage for the period are believed to be less than 0.2 in. and were not considered significant in the water budget (table 4).

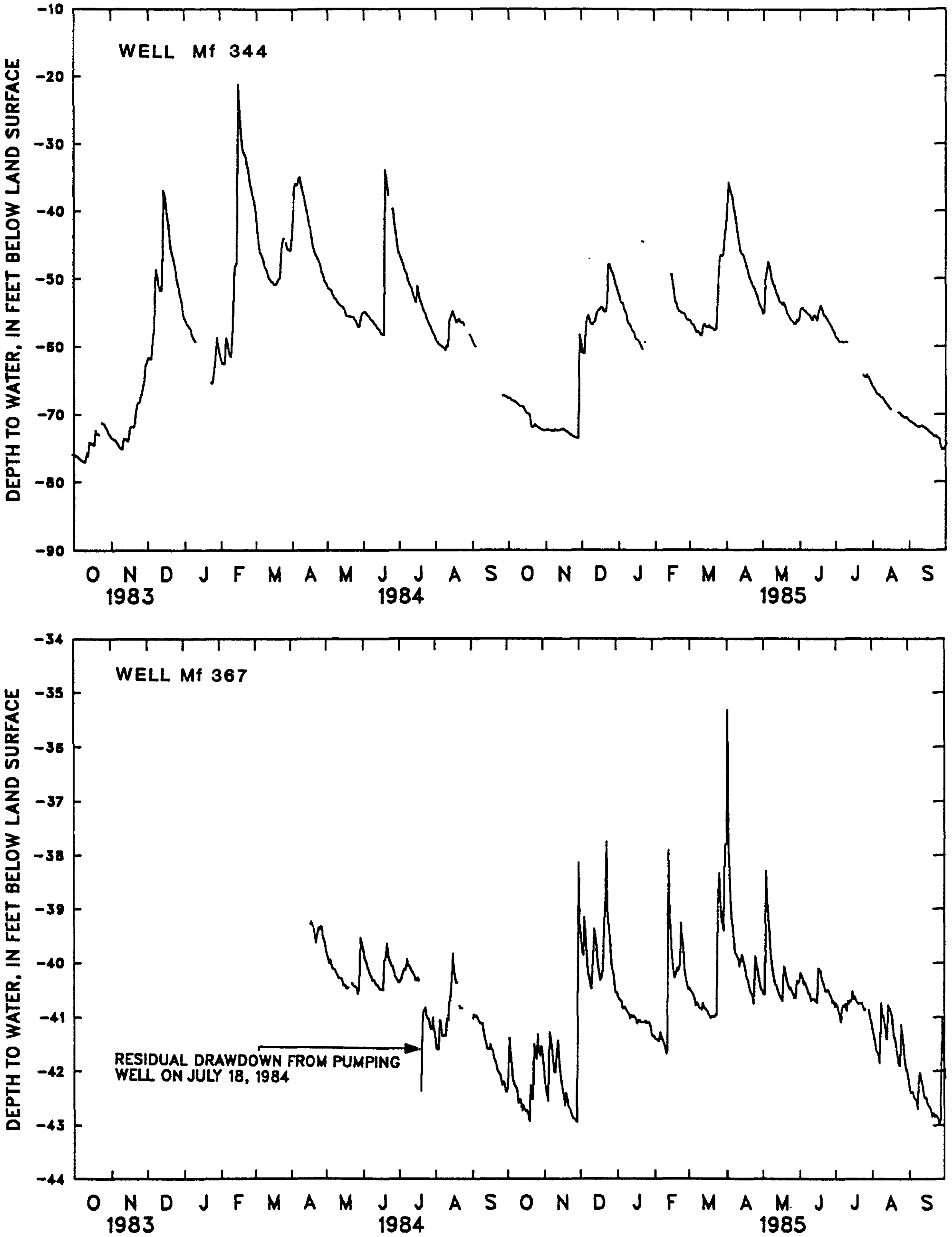


Figure 13--Water levels in wells Mf 344 and Mf 367.

Availability of Water

A reasonable estimate of the quantities of ground water available for use in the valleys can be calculated from the water-budget study. Most surface runoff moves out of the drainage basin within 3 days after the rainfall that produced it and is not available for in-basin uses. Ground water is the only continuously reliable source of water.

The average discharge of ground water to streams is 0.62 Mgal/d for each square mile of land surface in the Kishacoquillas Creek ground-water basin. Comparatively, 0.80 Mgal/d of ground water discharges for each square mile of land surface in the Spring Creek ground-water basin. These amounts are available for use even if none of the water re-enters the ground-water system after use. However, to have these amounts of water available, the ground water must be captured rather than allowed to leave the basin and severely deplete the streamflow. During drought years only 0.34 Mgal/d and 0.45 Mgal/d of water for each square mile in the Kishacoquillas and Spring Creek basins are available, respectively, based on the minimum annual ground-water discharges.

The calculated yields available from the Spring Creek basin can be extended to all the western carbonate valleys (Snake Spring, Morrison Cove, Canoe, and Nittany) because of their similar hydrogeologic characteristics. Extrapolation of the calculated yields available for the Kishacoquillas Creek basin to the remaining carbonate valleys is reasonable, but there is more diversity in hydrogeologic character between these valleys than between the western carbonate valleys.

The yields given are averages only and cannot be applied directly in any small area. Inhomogeneities in the hydrogeologic character of the rocks will reduce the yields below these averages in some areas and increase them in other areas. A comparison of area yields based on formation statistics and multiple-well aquifer tests is discussed in a later section of this report.

WATER YIELDING PROPERTIES OF ROCK UNITS

Aquifers are rocks or rock materials that store water in openings and transmit usable quantities to wells and springs. Openings in unconsolidated rock aquifers, such as the colluvium on the mountain slopes and the residuum under the valley floors, are the voids between packed grains. Openings in the consolidated carbonate-rock aquifers are separations along breaks in the rocks; some rock formations tend to develop more openings than others and are better aquifers. The breaks in the rocks include bedding partings, faults, and joints caused by physical stress. Any of these types of openings may be enlarged gradually by the chemical reaction of weak acids in water on the carbonate minerals that form these rocks. The size, spacing, distribution, and extent of interconnection of the openings determine the ability of the aquifer to store and transmit water.

Well Characteristics

A well must intercept at least one opening that is water-bearing to yield any water. Data on the distribution of water-bearing zones (WBZs) intercepted by many wells are useful in assessing the yielding properties of formations. Figures 14 through 18 summarize the statistics on WBZs below the bottom of casing, from well-completion reports filed by drillers with the Pennsylvania Bureau of Topographic and Geologic Survey. The distributions of WBZs in the Mines Member of the Gatesburg Formation and the Stonehenge Formation suggest that the sample size is too small for complete evaluation of the occurrence of WBZs. For most formations, the maximum number of WBZs are encountered turn 51 to 150 ft below land surface. For all wells in the Gatesburg Formation, the maximum number of WBZs are encountered at depths below 150 ft.

The ratio of the number of WBZs to total footage of hole drilled reduces the bias in the data created by shallow drilling. The open bars in figures 14 through 18 indicate that the number of WBZs encountered relative to the total footage of hole penetrated commonly is a maximum in the two shallowest 50 ft ranges. Further, the chances of encountering a WBZ are more evenly divided throughout the range of depth than is indicated by the raw data. WBZs have been encountered in the Gatesburg Formation only to depths of 450 ft, although 10 wells penetrate greater depths and 5 of these have reported WBZ data. However, because all but one of the five for which WBZ data are available yield more than 150 gal/min, additional small amounts of water encountered at greater depths may not have been detected during drilling. Therefore, WBZs may be encountered at depths greater than 450 ft in the Gatesburg Formation. Conversely, the WBZs reported to depths of 600 ft for wells in the Coburn through Nealmont Formations may be only another indication of the low yields available from these rocks. Small additional amounts of water intercepted during drilling are noticeable when the well yields little water. WBZs may be encountered at greater depths than the maximum shown by the bar graphs for other formations, inasmuch as the maximum depth of wells are the same, or only slightly deeper, for these formations than the deepest zone reported. Further, the number of WBZs for each 100 ft of hole drilled does not decrease markedly with depth for most formations, and actually increases for some formations.

Statistics about the depths of wells, casing, and static water levels are useful in inferring hydrogeologic characteristics of rock units and comparing different rock units. This information is helpful not only in understanding the hydrogeology but also in estimating well-construction costs. Median and quartile statistics of the frequency distributions of this data are shown graphically in figures 19-21.

The thick sandy residuum overlying the Gatesburg Formation forces the drilling of deeper wells in this formation than in other formations. Wells in the lower members and the undivided Gatesburg have a median depth that is 75 to 150 ft greater than that of wells in any other geologic unit. Similarly, the thick residuum and fine loose sand in some WBZs cause wells in the Gatesburg Formation to be cased to greater depths than most other geologic units.

Median water levels for all formations younger than the Nittany Formation range from about 30 to 60 ft below land surface. Older rocks, of the Nittany Larke, Stonehenge, Gatesburg, and Warrior Formations, crop out chiefly in central parts of western valleys and have median water levels that range from 60 to 120 ft. Water levels in the Gatesburg are the deepest of all formations and exceed over 400 ft in the widest part of the Nittany Valley.

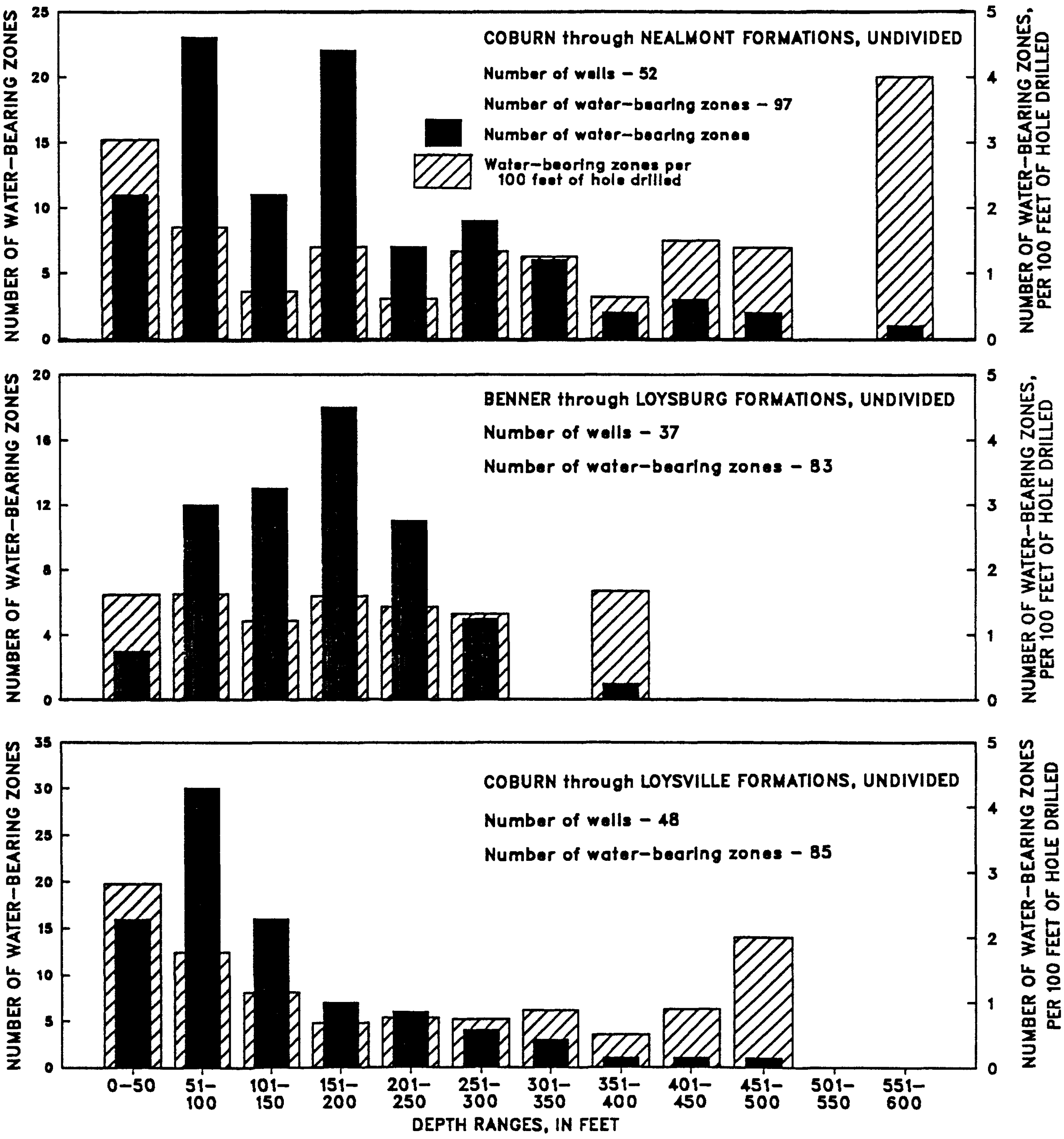


Figure 14.––Distribution of water-bearing zones in the Coburn through Loysburg Formations.

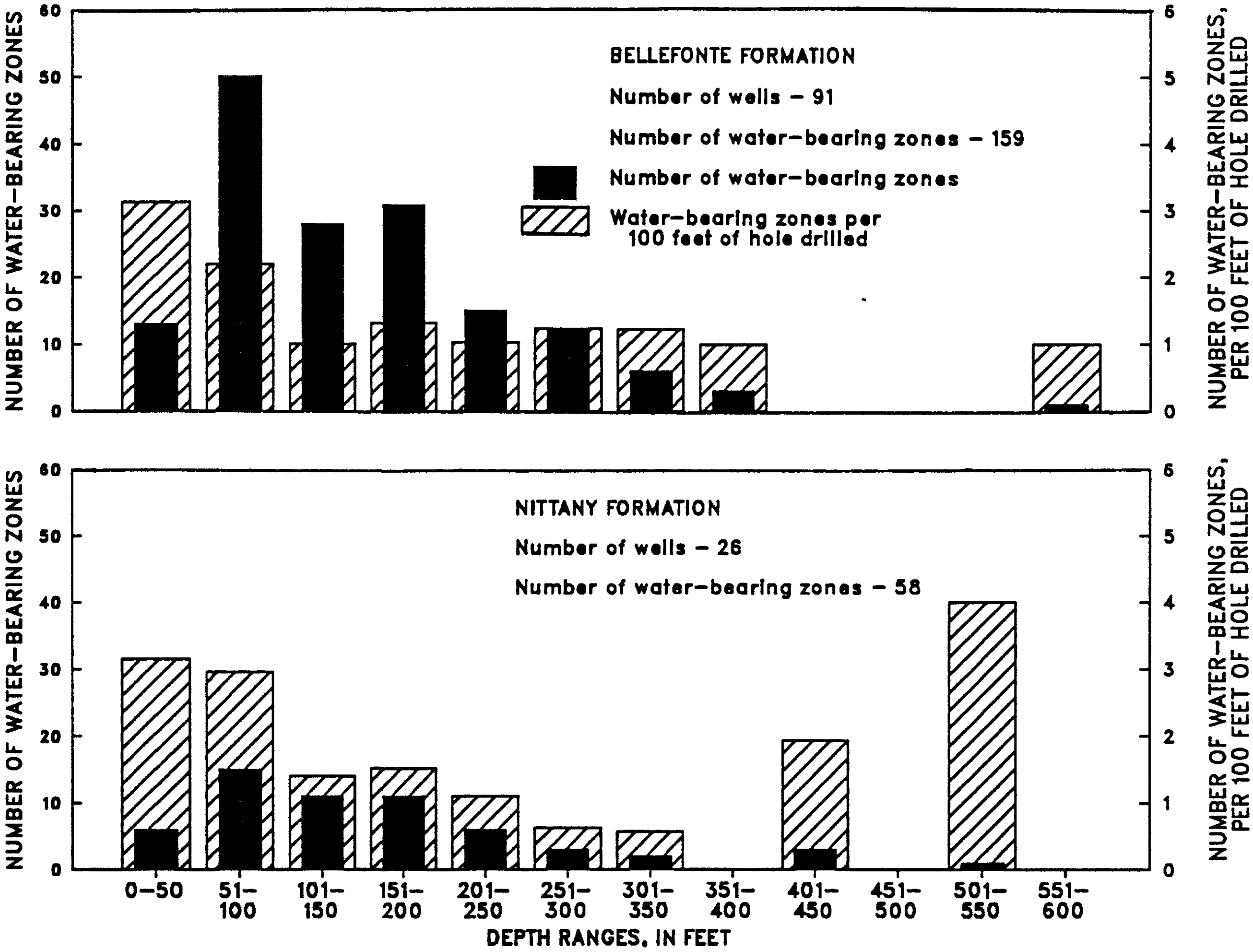


Figure 15.—Distribution of water–bearing zones in the Bellefonte and Nittany Formations.

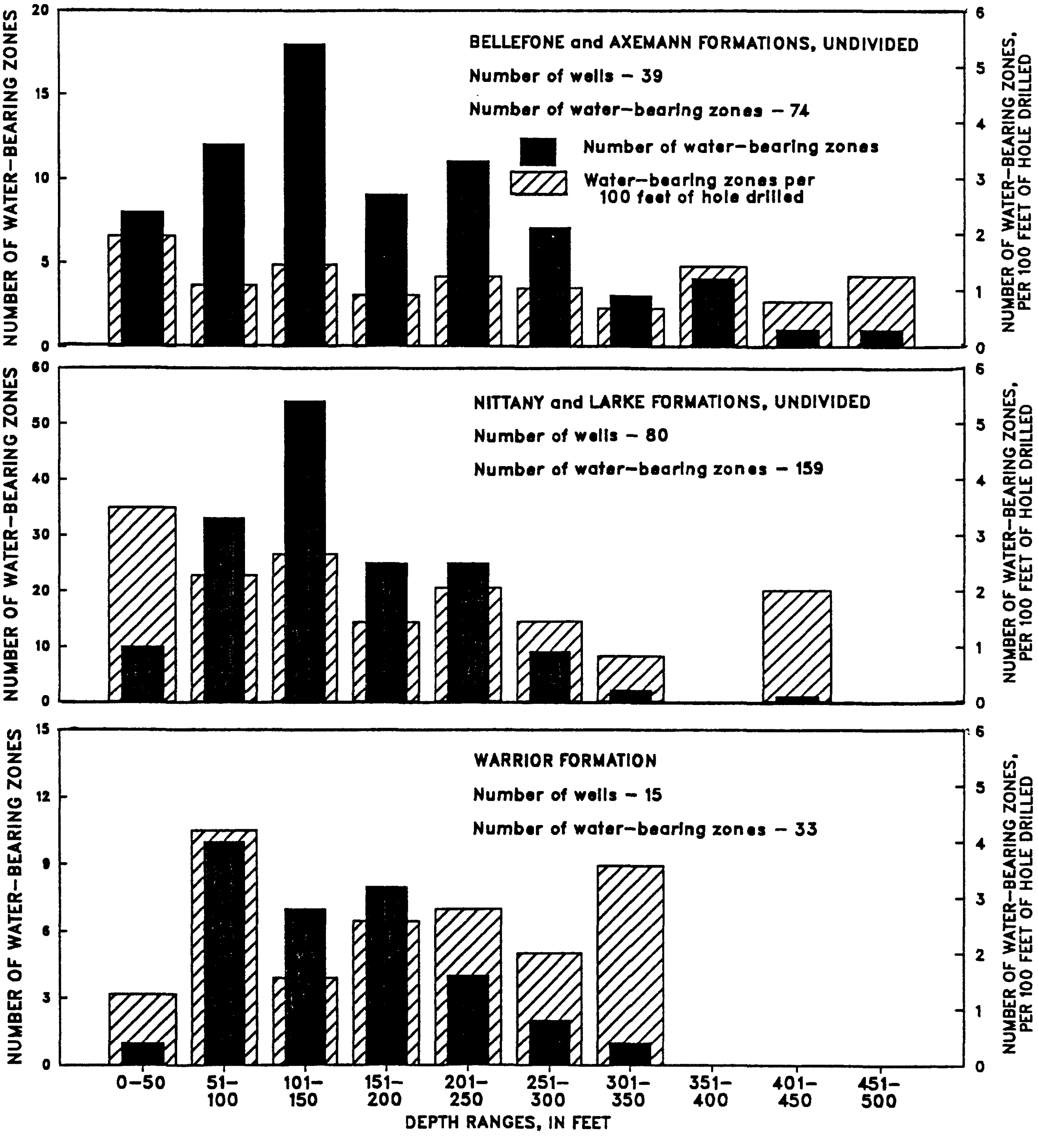


Figure 16.—–Distribution of water-bearing zones in the Bellefonte and Axemann Formations, Nittany and Larke Formations and Warrior Formations.

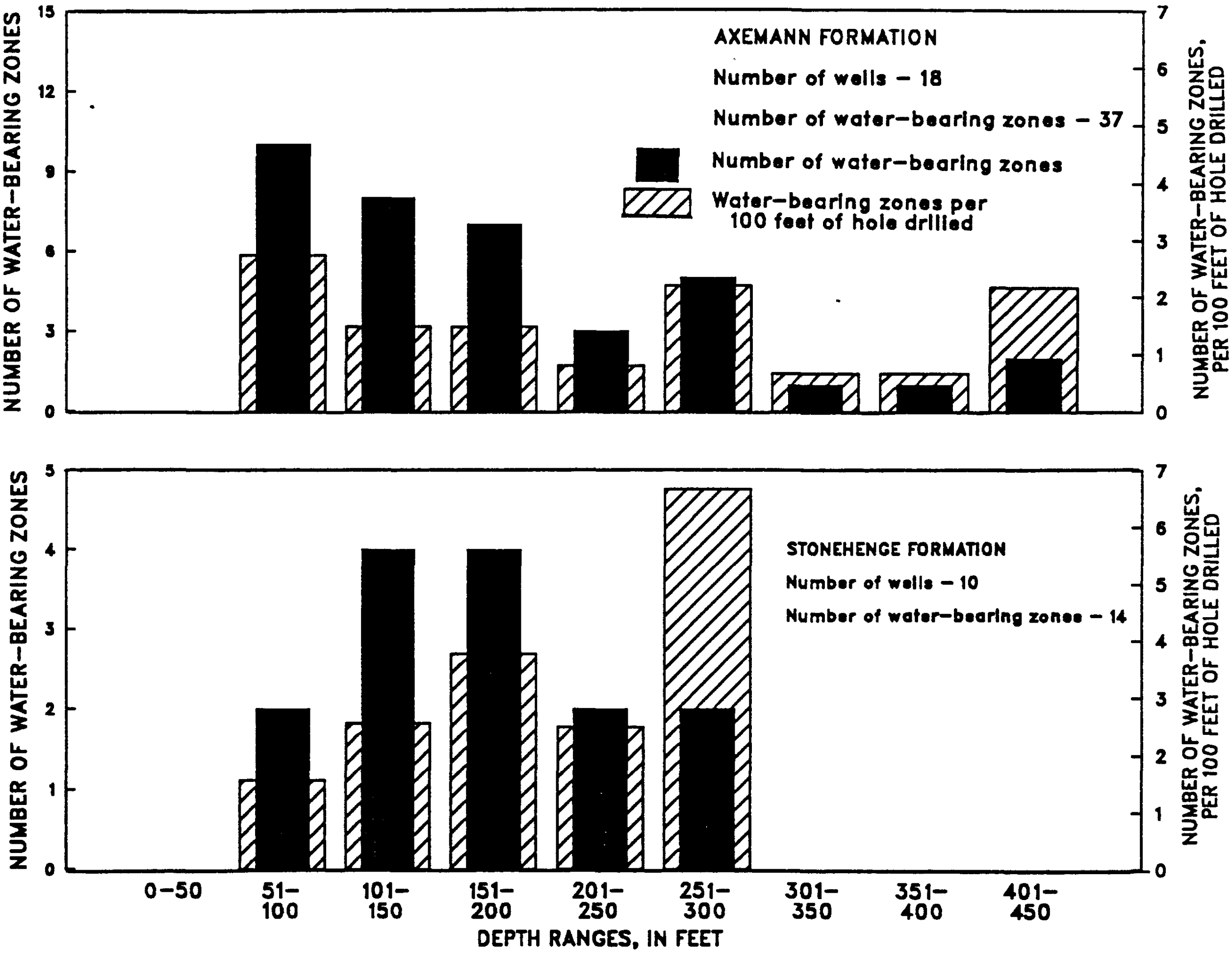


Figure 17.––Distribution of water–bearing zones in the Axemann and Stonehenge Formations.

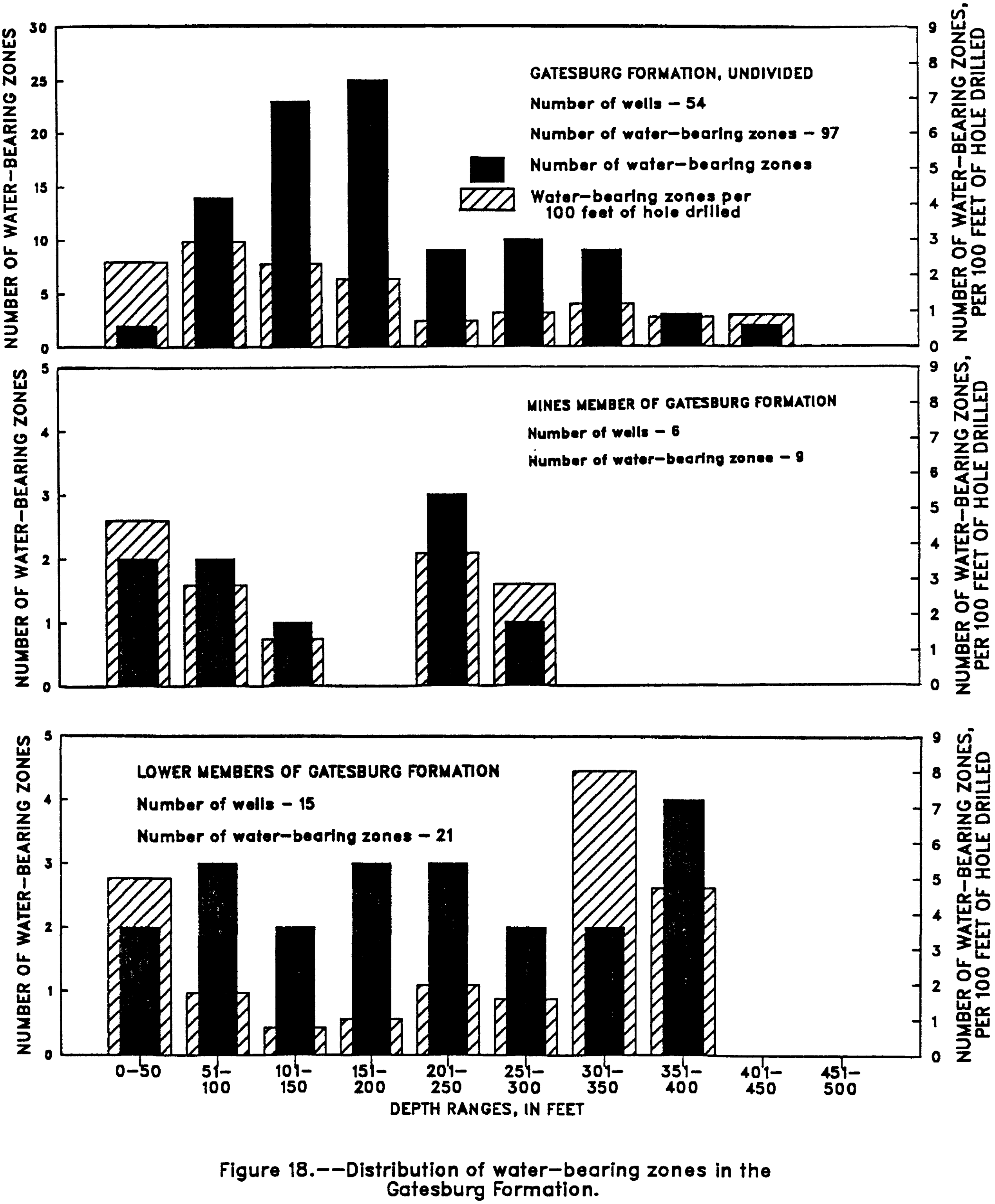


Figure 18.——Distribution of water—bearing zones in the Gatesburg Formation.

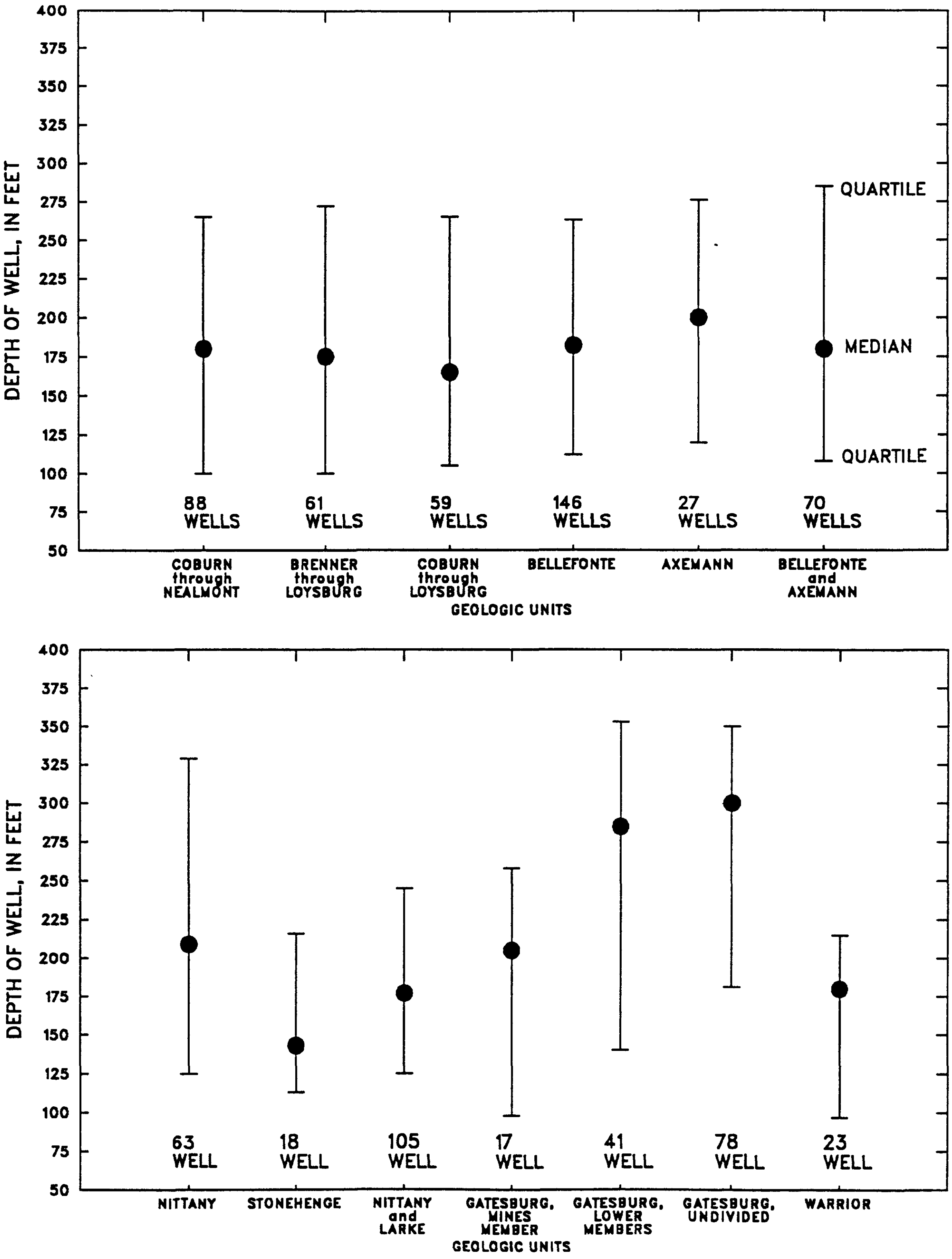
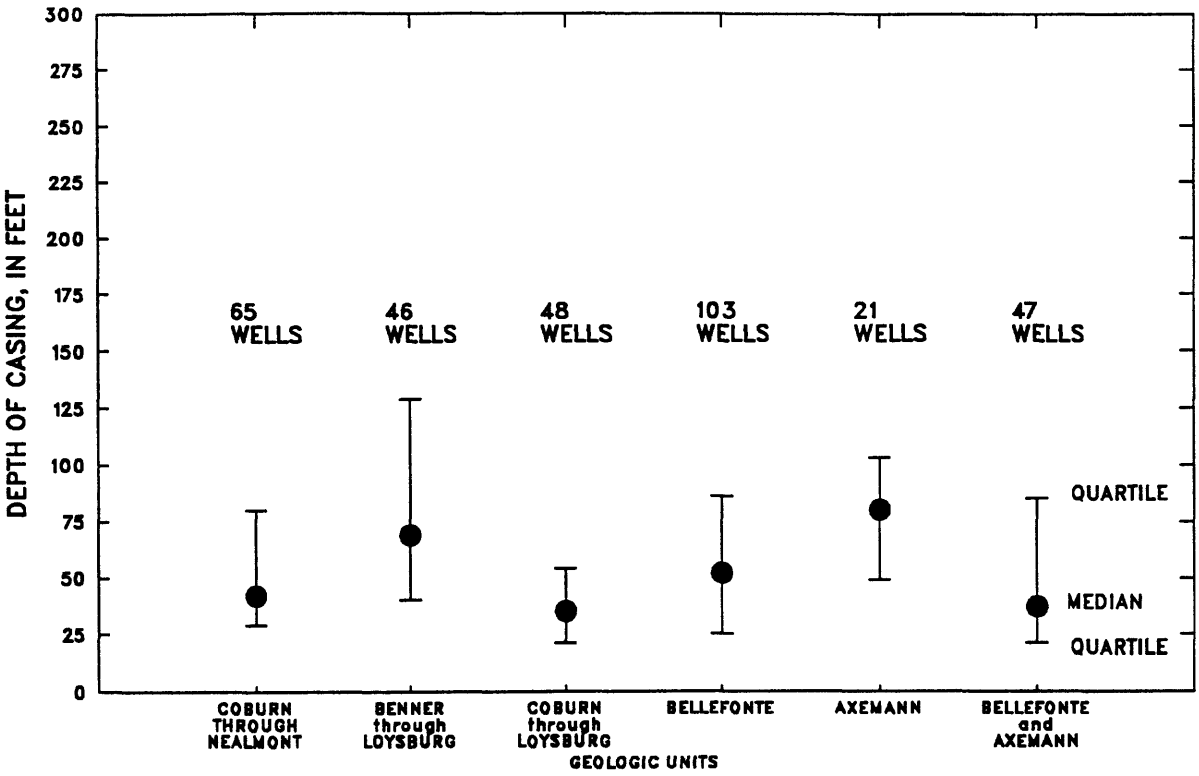


Figure 19.—–Quartile values of well depths, plotted by geologic unit.



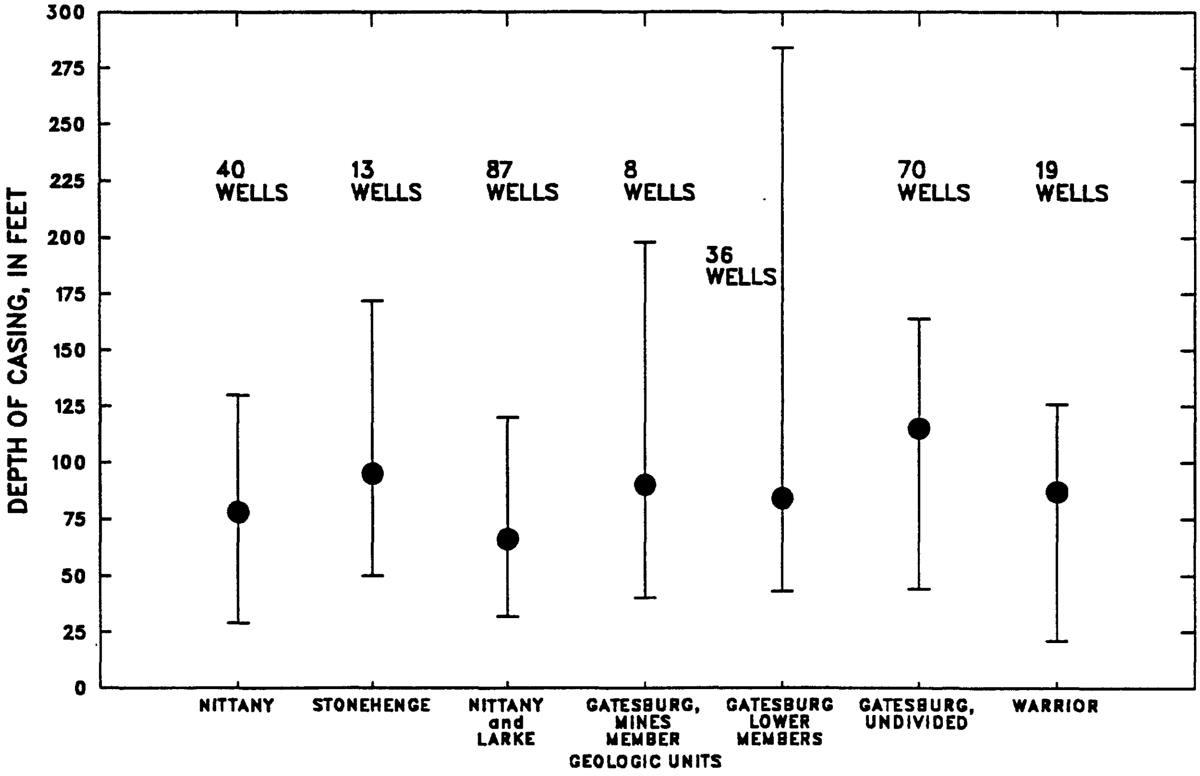
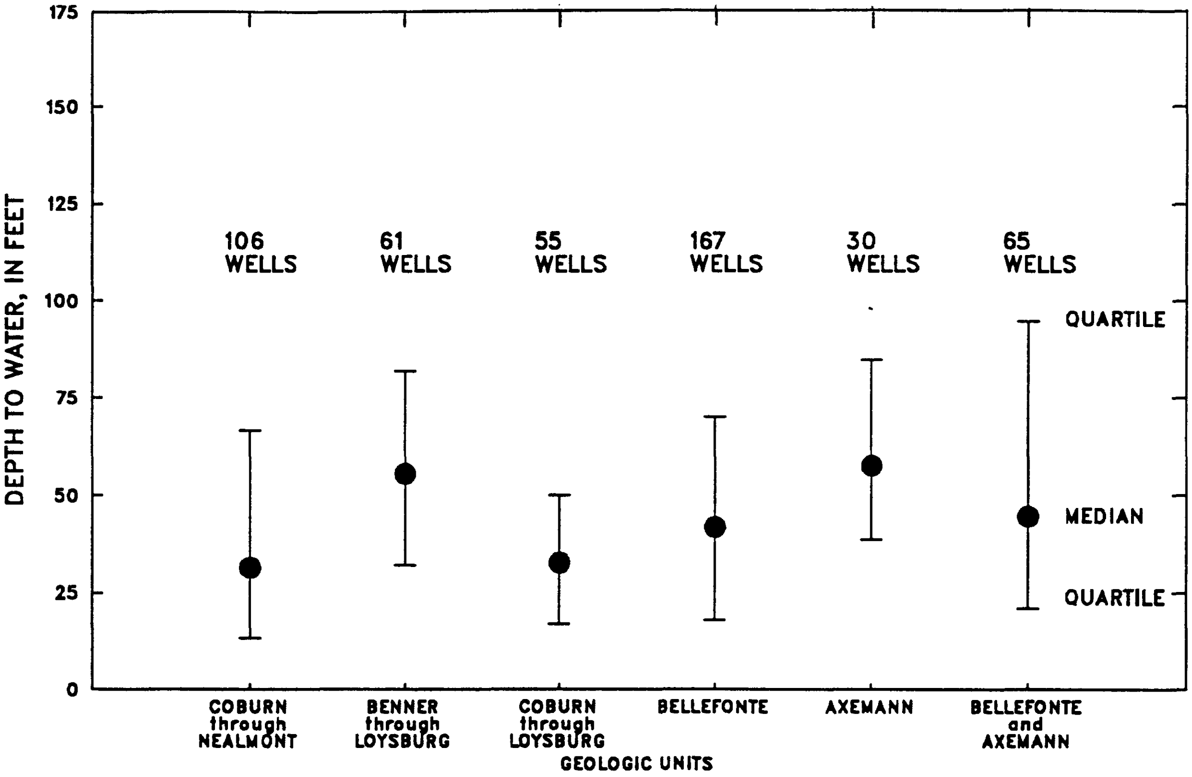


Figure 20.--Quartile values of casing depths in wells, plotted by geologic unit.



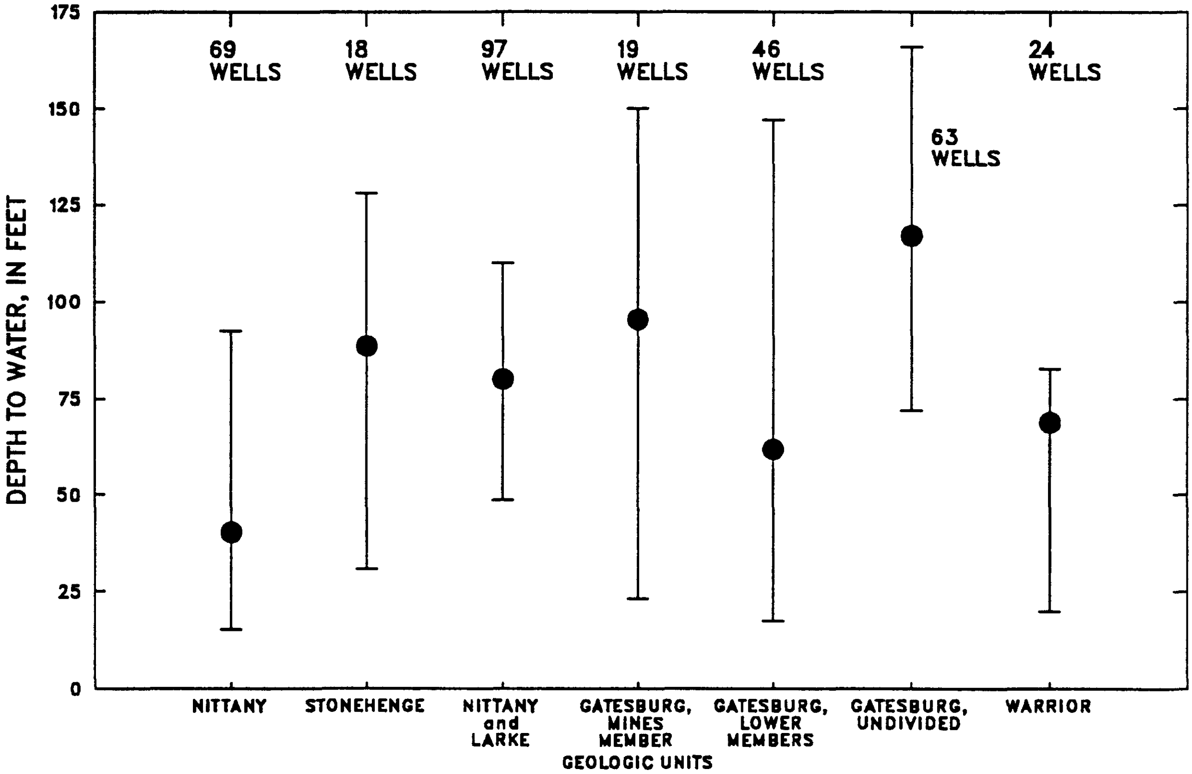


Figure 21.--Quartile values of the depth to water in wells, plotted by geologic unit.

Specific Capacity

Rock units differ greatly in their ability to supply water to wells. Data on the effects of pumping about 250 wells were used to evaluate the water-yielding capability of the various geologic units. The results of these tests are shown in table 1 as the specific capacity of the well. The data for a common pumping period of 1 hour was analyzed to reduce the variability of drawdown in water level caused by differences in the length of time wells are pumped. No compensation was made in the data for differences in the rates of pumping. A graphic summary of the quartile and median statistics of the specific capacity data for low-production-use wells is shown by geologic unit in figure 22. A comparison of the graphs indicates that the lower members of the Gatesburg Formation have the largest potential yield and the Benner through Loysburg, Axemann, Nittany, and Nittany and Larke Formations, have large but lesser potential yields. A similar graphic summary of high-production-use wells is shown for geologic units having sufficient data in figure 22a. A comparison of these graphs indicates results similar to the low-production-use wells.

Wells intended for high-production uses are sited and completed to maximize yield, but wells intended for low-production uses are sited and drilled to maximize convenience and minimize cost. The comparative statistics on these two general categories of use are shown in table 5 for those geologic units for which sufficient data are available. The statistics show that wells located and constructed for high-production uses will supply water at higher rates than wells intended for low-production uses. For wells in the Nittany and Gatesburg Formations, the median specific capacity of high-production-use wells is 30 to 55 times higher than that of low-production-use wells. The median specific capacities of high-production-use for wells in the lower yielding Coburn through Loysburg and Bellefonte Formations is about two to four times higher than low-production-use wells. Although the Coburn through Loysburg Formations have major conduits that transmit water from the mountain colluvium, these openings are inferred to be confined largely to shallow horizons. Otherwise, high yield wells that produce water from zones much below the zone of seasonal water table fluctuation would exist.

A comparison of the median specific capacities of all wells grouped by valleys shows a range of between 0.21 and 0.40 [(gal/min)/ft] with one exception. The median specific capacity of wells in the Nittany Valley is 6.4 [(gal/min)/ft]. About 75 percent of the data that produced this statistic are for wells in the State College area. Here the prolific yielding Gatesburg and Nittany Formations are areally more extensive than anywhere else in these valleys, and many of the wells were sited by professional hydrogeologists.

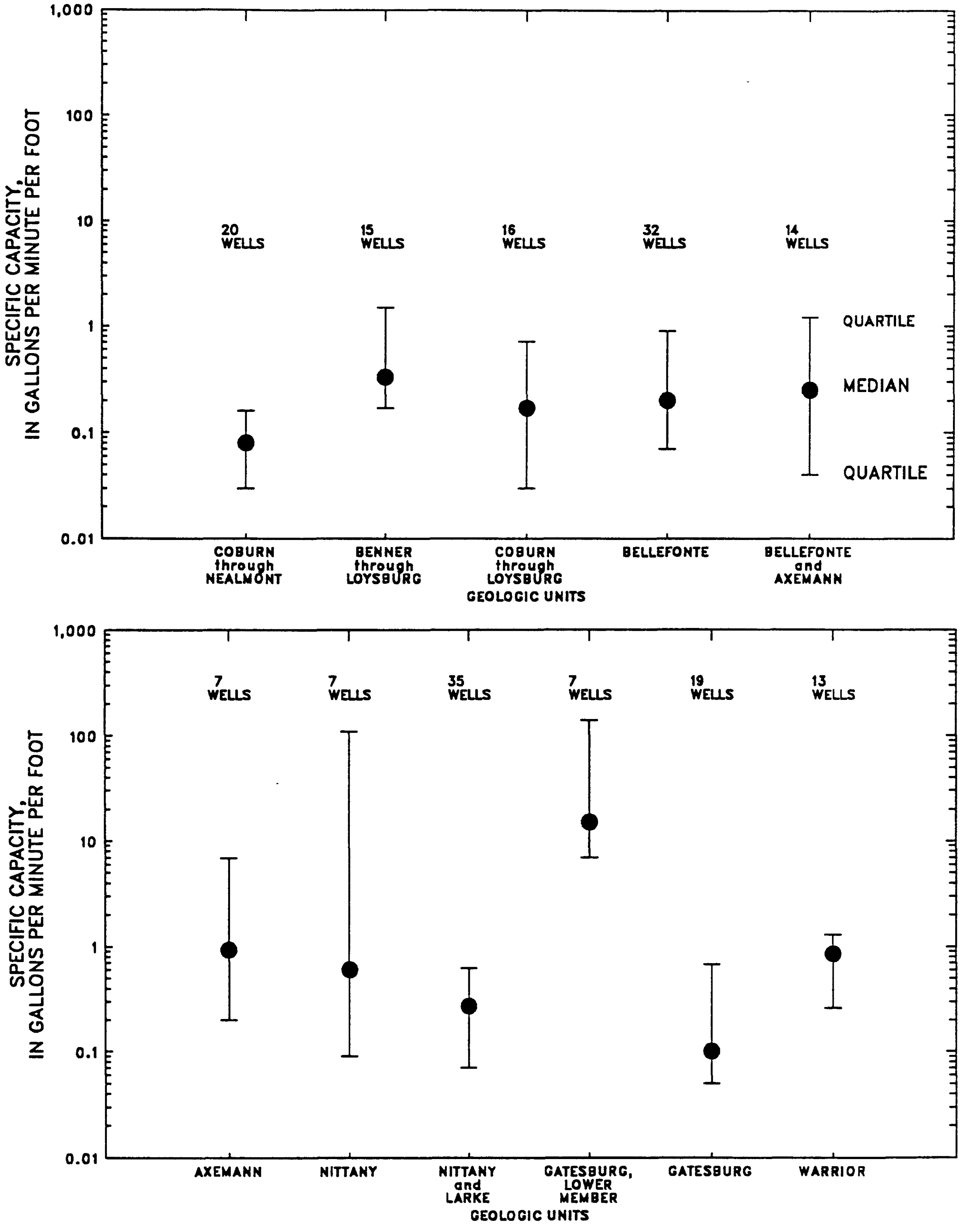


Figure 22.--Quartile values of the specific capacities of low-production-use wells, plotted by geologic unit.

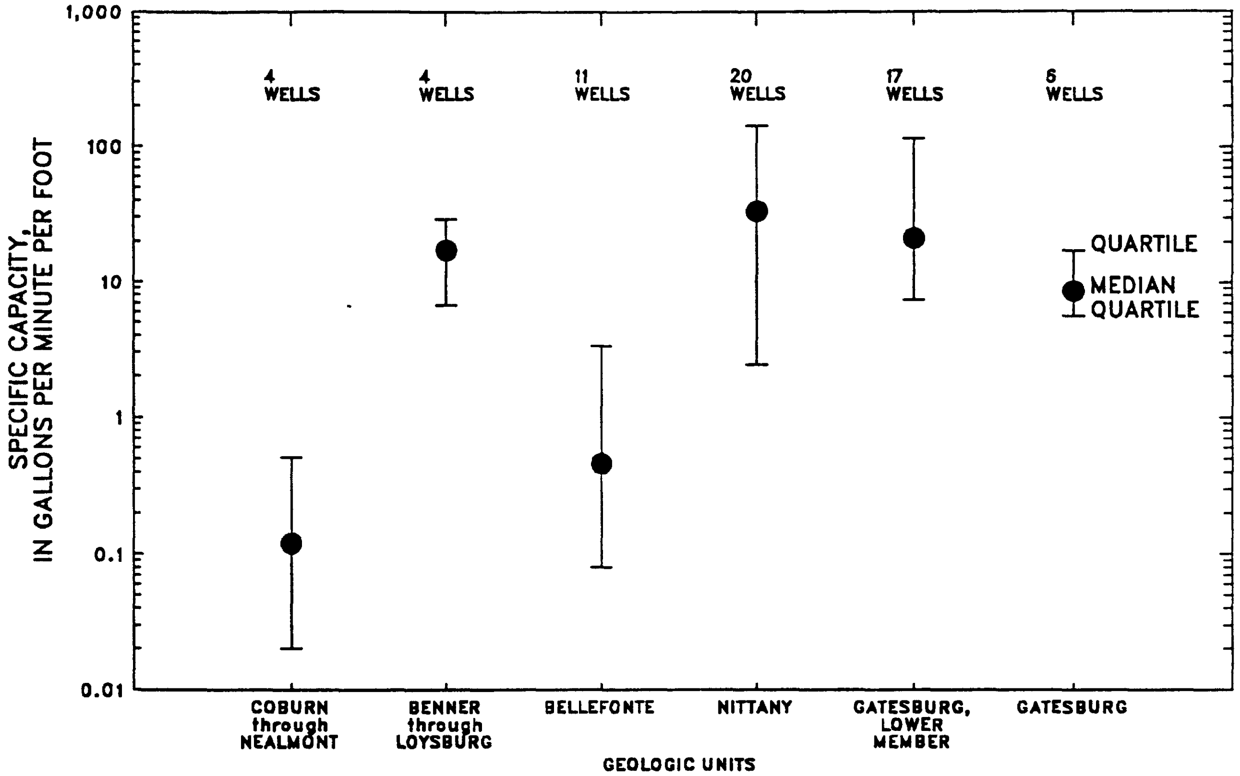


Figure 22a.--Quartile values of the specific capacities of high-production-use wells, plotted by geologic unit.

Table 5.--Comparison of yield and specific capacity for high- and low-production-use wells
[gal/min, gallons per minute; [(gal/min)/ft], gallons per minute per foot]

Geologic unit	Intended productivity	Reported yield (gal/min) Number of wells	Reported yield (gal/min) 25th percentile	Reported yield (gal/min) 50th percentile (median)	Reported yield (gal/min) 75th percentile	Specific capacity [(gal/min)/ft] Number of wells	Specific capacity [(gal/min)/ft] 25th percentile	Specific capacity [(gal/min)/ft] 50th percentile (median)	Specific capacity [(gal/min)/ft] 75th percentile
All Coburn through Loysburg Formations	High	22	60	30	12	9	17.0	0.62	0.12
	Low	134	30	10	5	51	0.44	.16	.04
Bellefonte Formation	High	25	85	26	11	11	3.3	.46	.08
	Low	77	25	12	7	32	.89	.20	.07
Nittany Formation	High	22	1,440	537	50	20	142	33	2.4
	Low	21	55	18	8	7	110	.6	.09
All members of Gatesburg Formations	High	28	916	325	63	24	83	13	7.1
	Low	74	46	15	6	28	5.0	.43	.07

Sustained Yield

Specific-capacity statistics also can be used to estimate a sustained yield--a quantity more directly useful in selecting areas for development of high production wells. A sustained yield is defined here as the amount of water, in gallons per minute, that can be obtained continuously from a well for 24 hours. It is calculated, for each of the geologic units, by multiplying the median specific capacity for 24 hours of pumping by the available drawdown. The specific capacity after 24 hours was calculated by reducing the median 1-hour specific capacity by the average decline in specific capacity observed in wells that were pumped for 24 hours. The average decline observed is 30 percent. The available drawdown is the difference between the median depth to water and the bottom of the depth range in which the median WBZ occurs. Table 6 summarizes the data by geologic unit. The median of yields reported by drillers on well-completion reports filed with the Pennsylvania Bureau of Topographical and Geological Survey and from other sources are shown in the last column of the table for comparison with the calculated yields. Calculated well yields equal or exceed median reported yields for all geologic units except the Coburn through Nealmont Formations. Some calculated yields are two or three times the reported median yield, but some are an order of magnitude greater. This suggests that most wells can yield more water than is reported.

The calculated sustained yields for high-production uses from the Nittany and Gatesburg Formations are biased by the preponderance of data for wells located in the vicinity of State College. Therefore, the sustained yield calculated for the Nittany is probably too high. However, high-production-use wells can be developed in other valleys in both these geologic units.

Table 6.--Calculated sustained yields of wells in selected geologic units
[gal/min, gallons per minute; [(gal/min)/ft], gallons per minute per foot; ft, feet]

Geologic unit(s)	Intended use	Median specific capacity [(gal/min)/ft] 1 hour	Median specific capacity [(gal/min)/ft] 24 hours	Median depth to water (ft)	Bottom of median WBZ range (ft)	Available drawdown (ft)	Calculated sustained yield (gal/min)	Median reported yield (gal/min)
Coburn through Nealmont Formations, undivided	All	0.09	0.06	22	100	78	5	10
Benner through Loysburg Formations, undivided	All	3.8	2.7	52	200	148	400	30
Coburn through Loysburg Formations, undivided	Low	.17	.12	32	100	68	8	8
Bellefonte Formation	High	.46	.32	50	150	100	32	26
	Low	.20	.14	41	150	109	15	12
Axemann Formation	Low	.93	.65	58	200	142	92	20
Bellefonte and Axemann Formations, undivided	Low	.25	.18	45	150	105	19	10
Nittany Formation	High	33	23	30	150	120	2,760	537
	Low	.60	.42	46	150	104	44	18
Nittany and Larke Formations, undivided	Low	.27	.19	80	150	70	13	11
Stonehenge Formation	Low	.49	.34	90	200	110	37	30
Gatesburg Formation	High	13	9.1	94	200	106	965	325
	Low	.43	.30	109	200	91	27	16
Warrior Formation	All	.85	.60	69	150	81	49	17

Factors that Influence the Yield of Wells

Lithology and Structure

Lithology is the most important of all factors that influence the yield of wells. In carbonate rock, both fracture openings (bedding separations, joints, faults) and the degree of their enlargement are controlled by the type of carbonate mineral, the type and amount of noncarbonate material, rock texture, and contrasts in lithology between adjacent layers of rock. Differences in the spacing, orientation, and interconnection of openings formed by the physical stresses acting on the rocks are related to differences in lithology. Enlargement of the openings is related to both the accessibility of component minerals to water and their relative solubilities. Studies of the influence of lithology and structure on the geohydrology of carbonate rocks have been reported by many workers.

Lithology

Rauch and White (1970) in a study of cave volumes in the Coburn through Loysburg Formations of the Nittany, Penns, Brush, and Sugar Valleys found that the majority of caves are restricted to several beds in a zone about 450 ft thick. Their study concluded that caves are formed preferentially in limestone and in limestone with low dolomite concentrations or silty streaks but rarely in dolomite. Cavity development is enhanced by small grain size and bulk rock purity. High concentrations of clay and other insolubles inhibit cavity formation.

The work of Meisler and Becher on the relation between lithology and yield (1971, p. 49) was based on specific capacities of wells in a thick sequence of carbonate rocks in Lancaster County, Pennsylvania. They conclude that limestone has a greater yield capability than does dolomite. They also found that high concentrations of clay, silt, and sand inhibit the yield capability of carbonate rocks. A comparison of the distribution of specific capacities and the gross lithologic character of rock units in this study gives results similar to the Lancaster study, with some exceptions. The Bellefonte and Warrior Formations are dolomite units and many beds in the Coburn through Loysburg Formations contain large amounts of clay. For these formations, the specific capacity distributions are low compared to the distribution for the Axemann Formation (dominantly limestone) as shown in figures 22 and 22a. The larger values of specific capacities in distributions for both the Nittany and Gatesburg Formations appear to be contrary to the Lancaster study findings. However, the Lancaster rocks have mixtures of clay, silt, and sand within a carbonate matrix. Both the Nittany and Gatesburg Formations have beds of carbonate-cemented sandstone interbedded with the purer dolomite beds. Removal of the cement has created a porous fabric and enlarged cavities.

Structure

Deike (1969) showed that the orientation of joints in limestone of central Pennsylvania correlate with local structure and cave passage orientations. The major and minor trends of passages for caves with more than 300 ft of passageway are shown on cave maps published by the National Speleological Society (Speece and Cullinen, 1972 and 1975; Dayton and White, 1979; and Dayton and others, 1981). The cave locations and passage trends are shown in plates 1 and 2[3]. These trends can be correlated with the trends of local fracture traces to aid in selecting the best sites for drilling high-production wells.

Fracture traces are linear features visible as tonal contrasts on aerial photographs and are attributed to vertical or near vertical fractures or zones of fracture concentration in the subsurface rock (Lattman, 1958, p. 569). Wells drilled on fracture traces have tended to be more productive than those located at random (Lattman and Parizek, 1964; Parizek and Drew, 1966; Siddiqui, 1969; Siddiqui and Parizek, 1971; Becher and Root, 1981, p. 35-37). Many of the high-production wells used for data collection in this study were located with the aid of fracture traces. Use of fracture traces for the selection of drill sites is done best at the field location with aerial photographs. Geologic knowledge and skill in interpreting aerial photographs are needed to apply this method.

A comparison of the distributions of specific capacity and reported yield for wells located on or near faults with the distributions for all wells does not suggest that faults increase well productivity. The median specific capacities and quartiles for both distributions are virtually identical (median 0.4 [(gal/min)/ft]) and the quartile values for reported yield actually are slightly lower for wells near or on faults than for other wells.

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[3] Plates are on file in the U.S. Geological Survey, Pennsylvania District Library.

Topography

Many studies (Meisler and Becher, 1971; Wood, 1980; Becher and Taylor, 1982) have evaluated the relation of topography to well yield using specific-capacity data. In general, wells in lower topographic positions have greater yields than wells in higher positions. Valleys and draws tend to form where the rocks are most susceptible to physical or chemical weathering, whereas hills form on the more resistant rocks. Openings such as bedding separations, joints, faults, fracture zones, and enlargements of these features by solution promote rapid lowering of land surface and produce topographic lows. Topographic lows are the collecting areas through which all upgradient water eventually must drain, and therefore, these low areas have the ability to transmit greater amounts of water for each unit volume of rock than do topographically higher areas.

An analysis of the relation between topography and the specific capacities of wells gave results similar to earlier studies and are shown below. The statistics are shown separately for high- and low-production uses. Of the 41 high-production-use wells in the distribution, 71 percent are in topographically low areas but, of the 215 low-production-use wells, only 48 percent are in topographically low positions.

Relation of topography to median specific capacity
[No., number; MSC, median specific capacity
in gallons per minute per ft]

Category of use[1]	Hilltop wells		Hillside wells		Wells in undulating or flat		Wells in gullies or draws		Valley wells	
	No.	MSC	No.	MSC	No.	MSC	No.	MSC	No.	MSC
High	2	3.0	10	0.35	3	6.6	2	18.0	24	25.0
Low	16	.26	96	.2	20	.25	3	9.7	80	.56

[1] High = high-production-use; Low = low-production-use.

Specific Yield

Specific yield is an estimate of the volume of water that can be obtained from a unit volume of aquifer by gravity drainage. As a unit measure of aquifer storage, it may be used to calculate the effects of ground-water development or drought on water levels. Specific yields were calculated for the zone of water-table fluctuation in the carbonate rocks of the Spring Creek and Kishacoquillas ground-water basins. The calculations were based on discharge of groundwater from the basin and the average change in ground-water levels during periods when no direct runoff was leaving the basin and no snow was on the ground. The average changes in water level were determined from continuous recording instruments on wells in carbonate rocks of the basin. These values were corrected to represent basinwide changes by using the ratio of the spring-to-fall average change in water levels for recorder wells to the average in water levels for all measured wells in the basin.

Spring Creek Basin

An average specific yield of 0.015 was calculated for the carbonate rocks in the Spring Creek basin for four periods ranging in duration from 7 to 14 days. Each period began at least 3 days after the last rain. Specific yields for individual periods ranged from 0.013 to 0.016; specific yields in fall were higher than those in spring. These values agree well with more elaborate calculations made for the basin by Giddings (1974, p. 71) and the mean value agrees exactly with Giddings' mean value of 0.015.

Kishacoquillas Creek Basin

An average specific yield of 0.017 was calculated for the carbonate rocks in the Kishacoquillas basin for eight periods ranging from 6 to 10 days in duration. The values for individual periods ranged from 0.009 to 0.038; the higher values prevailed in late winter.

Table 7.--Summary of hydraulic properties and theoretical drawdowns typical of the aquifer after 180 days of pumping

Geologic unit(s)	Transmissivity (feet squared per day)	Storage coefficient	Discharge (gallons per minute)	Drawdown, in feet		
				Distance from pumped well		
				100 feet	500 feet	1,000 feet
Coburn through Nealmont Formations, undivided	[1]15	[2].015	10	37	8	2
Benner through Loysburg Formations, undivided	[1]560	[2].015	100	18	10	7
Coburn through Loysburg Formations, undivided	[1]25	[2].015	25	60	11	4
	[3]680	[3].11	100	12	5	2
Bellefonte Formation	[1]40	[2].015	50	90	29	10
Axemann Formation	[1]200	[2].015	100	43	20	11
Bellefonte, Axemann Formations, undivided	[1]40	[2].015	50	90	29	10
Nittany Formation	[3]3,800	[3].008	200	8	5	4
	[1]5,200	[2].015	500	12	8	6
	[3]120,000	[3].015	1,000	1.4	1	0.9
Nittany and Larke Formations, undivided	[1]40	[2].015	50	90	29	10
Stonehenge and Larke Formations, undivided	[1]80	[2].015	50	50	21	5
	[3]7,600	[3].08	500	9	5	4
Gatesburg Formation	[1]2,000	[2].015	200	12	7	6
	[3]2,700	[3].04	500	23	13	9
	[3]5,000	[3].04	1,000	27	17	12
Warrior Formation	[1]50	[2].015	50	69	24	9

[1] Based on median specific capacity data. [2] Based on specific yield. [3] Based on aquifer-test data at well field.

Hydraulic Characteristics and Well Interference

Wells compete for the same water when they are too closely spaced. Overlap in drawdown reduces the yield of any well within the zone influenced by pumping from another well. In general, such well interference increases as the space between wells decreases. Drawdowns in the zone influenced by a pumped well are determined from the hydraulic properties of transmissivity and storativity for the aquifers. Table 7 summarizes transmissivities determined from aquifer tests in well fields (Moody and Assoc., 1967a,b, 1970a; State College Borough Authority, 1982) and transmissivities derived from specific-capacity data. Table 7 also gives theoretical drawdowns, based on the methods presented by Theis (1963, p. 10-15), for several of the geologic units. Storage coefficients shown are the average specific yield of 0.015 determined for the carbonate valleys or calculated from well-field aquifer tests.

Actual drawdown will differ from theoretical drawdown because of the heterogeneous nature of these aquifers and normal recharge from precipitation. In fractured-rock aquifers, interference will be greatest along some preferred direction, commonly parallel to bedding, joints, or solution features, whichever is the dominant direction of interconnection. In the carbonate valleys, the preferred direction is generally parallel to the strike of bedding and therefore to valley orientation. Local orientation can differ significantly. The ratio of strike to cross-strike transmissivity, or the anisotropy of the ground-water systems in these valleys, ranges from about 1.5 to 12 and averages about 5 on the basis of hydraulic gradients on the water table.

Table 7 can be used to estimate the spacing needed to minimize interference between wells or to estimate the effects of sustained pumping during periods of drought. Drawdowns for any discharge rate can be calculated from the table because drawdown is directly proportional to discharge. Reducing the discharge by half will also reduce the drawdown at the well by half. However, distances calculated from pumping centers will be distorted by the anisotropy of the ground-water system.

Problems Related to Water Availability

Most problems arising from inadequacy of ground water to meet demands are local and relate generally to the yields of individual wells and not to the capability of the rocks to supply water. Wells that yield from shallow WBZs, especially those WBZs in the zone of water-table fluctuation, will probably be unable to supply demands during periods of drought. Most of these wells are used for domestic supply. Drought commonly causes a flurry of well drilling to replace or deepen such wells. Yields from wells used for public supplies commonly decline when drought lowers the water table. However, these problems can be solved by the addition of extra wells to the system, spaced sufficiently apart to reduce the likelihood of interference.

Nittany Valley

Water levels contoured on plates 1 and 2[4] show a trough in the water table from pumpage only in the vicinity of Pleasant Gap. However, major well fields in the State College area pump an average of 8.1 Mgal/d. On the basis of the specific yield of 0.8 [(Mgal/d)/mi^2] determined for the Spring Creek basin, water must be pumped from an area of 10 mi^2 to supply the average demand during normal recharge conditions. In droughts, the specific yield could decline to 0.45 [(Mgal/d)/mi^2] and the total area needed to supply average demands would then expand to about 18 mi^2. Although the total area around the several well fields that supply water exceed these area needs, pumpage levels are great enough to warrant concern for long-term effects on ground-water levels.

The hydrograph of well Ce 118, since 1984, suggests that pumpage may affect water levels in the vicinity of State College (fig. 9). This well is about 2 mi southeast and nearly on strike with a new well field (wells Ce 652, 653, and 654) put into production in 1984 by the borough of State College. The gradient on the water-level recession for Ce 118 in 1985 is steeper than that in 1984 and the annual maximum and minimum water levels in 1985 are lower than those in 1984. Further, there was no annual rise in water level in 1986; rather, there was a gradual decline. Data for 1987 (not on graph) shows the normal annual rise and fall, but the summer high and winter low are lower than for both 1984 and 1985. The data indicates a long-term downward trend in water level that may be related to pumping. However, because Ce 118 is in the Gatesburg Formation, this trend could be related to the long lag in recharge reaching the deep ground-water system that was discussed earlier in this report.

Morrison Cove

Pumpage of about 0.14 Mgal/d from the Martinsburg Borough Authority wells has had no detectable long term effect on water levels. No trough shows in the spring water table on plate 2[4] in the vicinity of pumped well Ba 330 nor in the fall water table (not shown). The observation well Ba 329, which is located along strike and about 255 ft to the southeast of Ba 330, does show some effects of the intermittent pumping of Ba 330 (fig. 23). However, the general rising trend of water level, shown on the hydrograph during the summer of 1984 for well Ba 329, and caused by the lag in response to recharge typical of the Gatesburg Formation, may counteract the effects of pumping in the surrounding area. The hydrograph of well Ba 369 on figure 23 in the undivided Nittany and Stonehenge Formations, about 4 mi southwest of Ba 329, shows the normal water level response to seasonal recharge.

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[4] Plates are on file in the U.S. Geological Survey, Pennsylvania District Library.

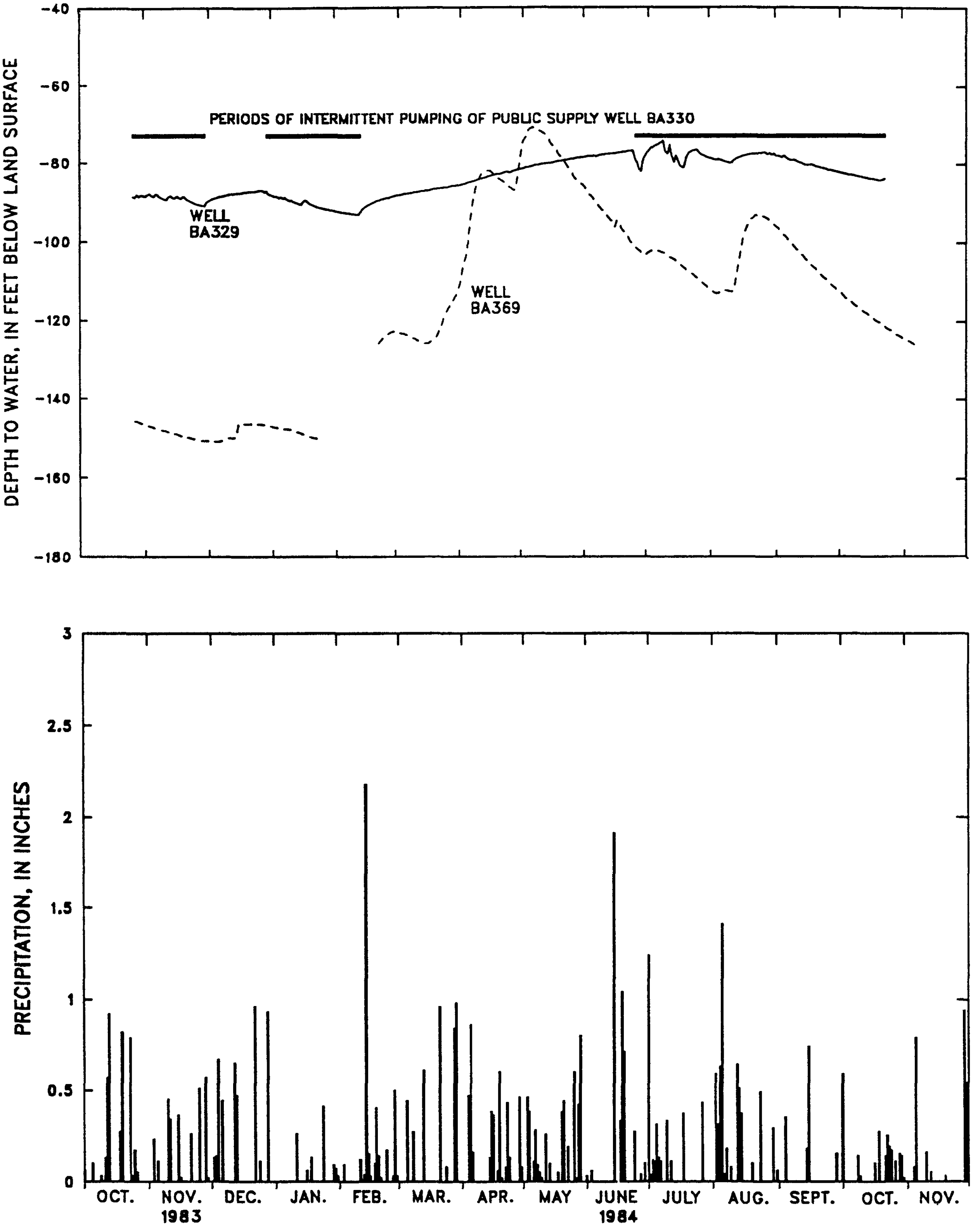

Figure 23.--Water levels in wells Ba 329 in the Gatesburg Formation and Ba 369 in the undivided Nittany and Larke Formations and precipitation at Martinsburg, Pennsylvania, October 1983 to November 1984.

QUALITY OF GROUND WATER

Physical Properties

Water in the carbonate rocks is suitable for most uses but is hard. Routine field measurements of specific conductance, hardness, and pH of well and spring water are shown in table 1 (Record of Wells) and in table 2 (Record of Springs).

Temperature

Natural water temperatures range from 7 to 16.5°C (degrees Celsius) and vary only a few degrees annually. The temperature, its small variability, and plentiful supply in the carbonate rocks make ground water an excellent cooling and air-conditioning agent as well as a good source of geothermal heat.

Specific Conductance

A direct relation exists between specific conductance and dissolved-solids concentration (Hem, 1970, p. 96-101). Therefore, to calculate the approximate value of dissolved solids, in milligrams per liter, for ground water in the valleys, the specific conductance can be multiplied by 0.62. Estimates of specific conductance can be made on the basis of the specific-conductance zonation maps in plates 1 and 2[5].

An evaluation of the areal distribution of specific conductance in each of the valleys suggests some chemical characteristics are related to the rock unit and others are related to land use. In general, water from the Gatesburg Formation, in all valleys in which it outcrops, has a specific conductance that ranges from 250 µS/cm to 400 µS/cm (microsiemens per centimeter at 25°C). These are the lowest values of specific conductance found in the carbonate rock units. Water in the Gatesburg Formation is in contact with carbonate minerals to a lesser degree than it is in other units either because much of the water moves through large conduit openings or through residuum and sandstone from which most of the carbonate minerals have been leached. The specific conductance of water from all rocks in Sugar Valley also is much lower there than in other valleys and ranges from 200 to 400 µS/cm, except in one small area where greater values probably are the result of some local anthropogenic activity. Water from other rock units in all valleys has specific conductances ranging from about 400 to 700 µS/cm. Higher values are shown on the inset maps of plates 1 and 2[5] where clusters of specific conductance greater than 700 µS/cm were measured. These values suggest that above-normal dissolved-solids concentrations are present and are related to contaminants entering with recharge to the ground water.

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[5] Plates are on file in the U.S. Geological Survey, Pennsylvania District Library.

The more numerous pockets of specific conductance above 700 µS/cm seen in the Nittany Valley probably indicate that human activities are more actively contributing to increases in dissolved-solids concentrations. When human activities of man intensify, zones of elevated specific conductance will tend to coalesce as the general ground-water quality declines. Because the Nittany Valley is the most populated of the valleys in the study area, such effects should be seen there first.

In Big Cove Creek Valley, the specific conductance progressively changes from low values of 250 to 400 µS/cm in the northern part of the valley, and from 400 to 500 µS/cm at the southern end of the valley, to 600 to greater than 700 µS/cm near the point of water discharge from the valley. A similar change can be seen in Locke-Blacklog Valley. The specific conductance of ground water in the Kishacoquillas Valley increases progressively from the sides and ends of the valley toward the central ground-water trough that drains the valley. A zone of elevated specific conductance (greater than 700 µS/cm) follows the ground-water trough. The valley is largely agricultural in character, and these elevated values of specific conductance are likely caused by farming practices.

Chemical Characteristics

pH

The median pH of ground water (a measure of acidity or alkalinity) is 7.4, but pH ranges from 6.2 to 9.5. Most of the ground water has a pH greater than 7.0, the value of a neutral water. The higher the pH, the greater the alkalinity of water. The median pH of 7.6 in water from the Gatesburg Formation is slightly higher than that in other geologic units.

Hardness

Hardness is a property of water that causes the formation of an insoluble residue when the water is used with soap. It is primarily caused by the presence of calcium and magnesium ions. Durfor and Becker (1964, p. 27) classified the degree of hardness as follows:

Hardness range (milligrams per liter of $CaCO_3$)	Description
0-60	Soft
61-120	Moderately hard
121-180	Hard
Greater than 180	Very hard

High hardness is undesirable for some uses of water because it forms scale on pipes and in boilers, and a curd in combination with soap.

Ground water in the carbonate rocks ranges from moderately hard to very hard. The median hardness of water from 550 wells is 205 mg/L. In general, hardness and specific conductance are directly related in carbonate rocks because calcium and magnesium bicarbonate comprise most of the dissolved mineral content.

The statistical distribution of hardness is shown in figure 24 for each of the geologic units and in figure 25 for all the valleys. Hardness of water changes progressively from the comparatively low values in the younger carbonate formations that border most valleys to the comparatively high values shown in most older carbonate formations that outcrop in central parts of most valleys. However, the median hardness of 137 mg/L in water from the Gatesburg Formation is the lowest value found in any of the carbonate rocks for reasons given in the discussion of specific conductance. Water moves too quickly through the fracture and conduit openings in the valleys for chemical equilibrium to be attained between solution and precipitation of carbonate minerals. The studies of Langmuir (1971) showed that less than 25 percent of the well and spring water in central Pennsylvania carbonate rocks had reached equilibrium with the host minerals calcite and dolomite.

Major Ions

Results of laboratory analyses of the major chemical constituents in water from 126 wells and 24 springs in the carbonate rocks are reported in table 8. Of the 150 analyses, 109 were done for this study on samples collected in July and August 1984 and in June, July, and August 1985, and the remainder for reconnaissance studies in 1980 and 1981 by Taylor and others (1982, 1985). Table 9 shows the maximum, minimum, and median values of each chemical constituent from each geologic unit that has at least four analyses. Values reported as < (less than) in table 8 were arbitrarily divided by two for the calculation of medians for iron and manganese distributions in table 9.

The MCLs and SMCLs established by USEPA (1986a and 1986b) for four constituents in drinking water are exceeded in several analyses. The SMCLs for iron, manganese, and dissolved solids are aesthetic goals and do not have health implications, but the MCL for nitrate in public supply systems is related to health. High nitrate content may be life-threatening, as concentrations in excess of 10 mg/L are known to cause methemoglobinemia, commonly called "blue baby disease", in infants.

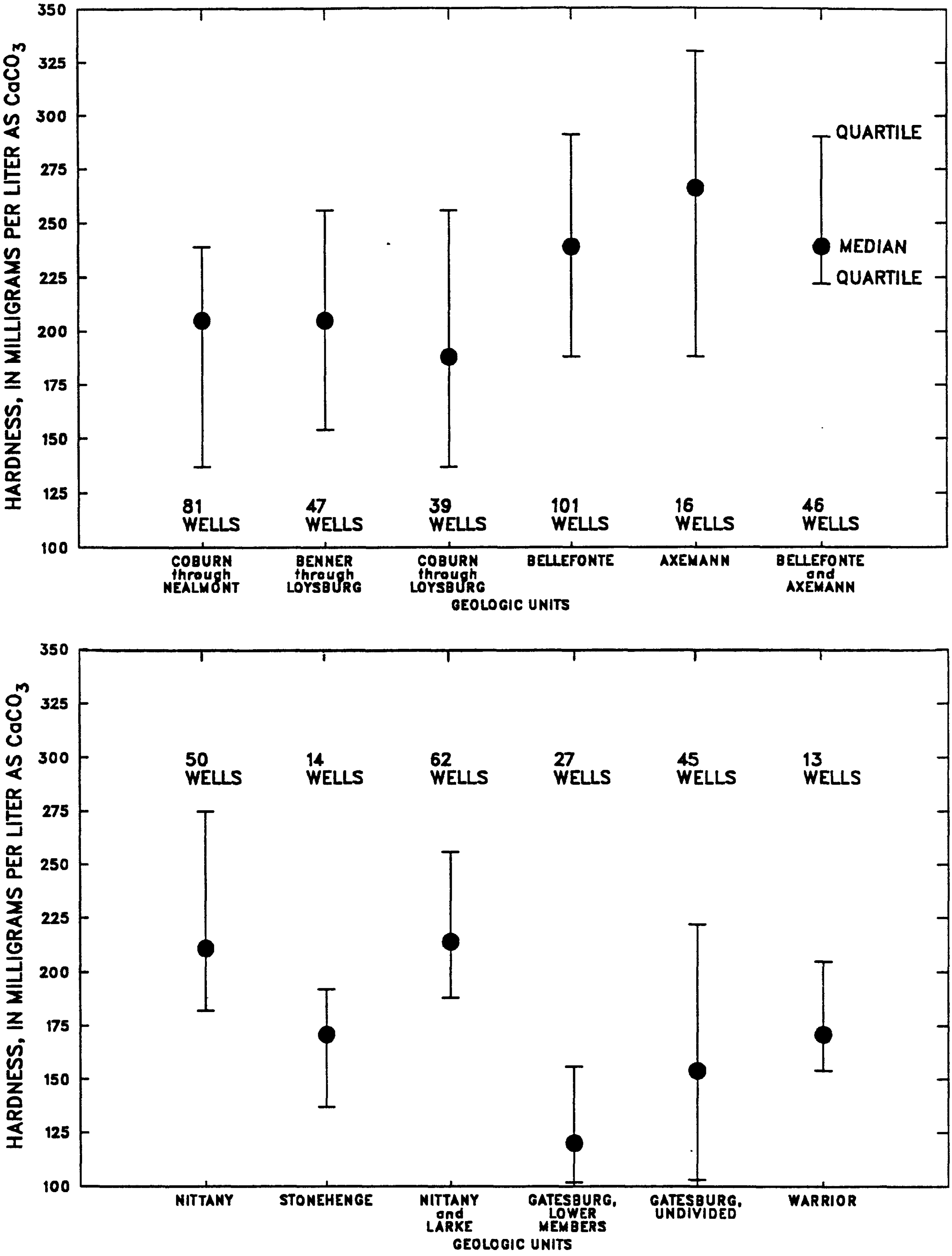

Figure 24.--Quartile values of hardness as $CaCO_3$ in wells, plotted by geologic unit.

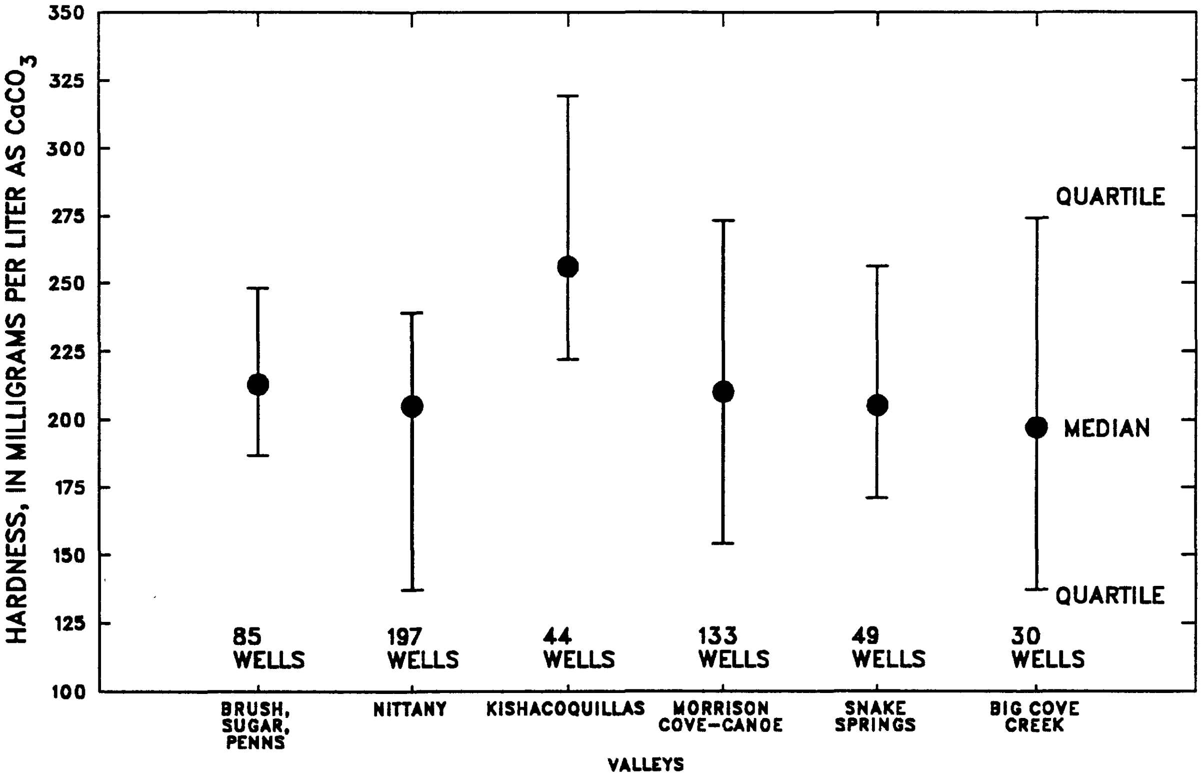

Figure 25.—–Quartile values of hardness as $CaCO_3$ in wells, plotted by valley.

Table 8.--Chemical analyses of major constituents in well and spring water
[µg/L, micrograms per liter; mg/L, milligrams per liter; <, less than; °C, degrees Celsius; --, no data]

County well or spring number	Date	Geologic unit[1]	Temperature (°C)	Iron, dissolved (µg/L as Fe)	Manganese, dissolved (µg/L as Mn)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity, lab (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)
Bedford County											
310	08-20-80	Oba	11.5	30	10	96	36	5.7	5.7	360	18
314	08-20-80	Oba	14.0	20	10	70	21	25	4.3	290	33
317	08-21-80	Ꞓw	--	90	10	38	21	9.0	2.0	170	20
389	08-27-80	Ꞓg	14.0	20	10	40	17	1.2	1.2	190	4.0
489	09-18-80	Ꞓg	12.0	10	10	51	28	0.5	0.8	240	1.0
502	08-14-84	Obf	12.0	<100	<50	61	36	5.2	11	258	14
508	08-13-84	Onl	12.0	490	<50	73	42	48	2.1	266	110
515	08-14-84	Ocl	12.0	<100	<50	83	35	3.3	.9	220	16
525	08-15-84	Onl	11.0	<100	<50	26	25	2.5	1.2	168	7.2
530	08-13-84	Obf	12.5	<100	--	48	30	1.1	1.0	184	10
531	08-15-84	Ꞓw	13.0	130	<50	45	28	.7	1.4	210	2.8
539	08-14-84	Onl	19.0	<100	<50	57	36	1.9	1.1	272	4.0
555	08-15-84	Ꞓg	12.0	<100	<50	69	33	1.1	.9	284	4.0
568	08-14-84	Ocl	12.0	<100	<50	70	5.6	7.9	.9	174	20
574	08-15-84	Obf	13.0	<100	<50	48	30	2.3	.9	204	8.8
592	08-23-84	Ocl	11.0	150	<50	--	--	--	--	124	14
608	08-23-84	Ꞓg	12.0	<100	<50	--	--	--	--	224	7.0
621	08-23-84	Oba	12.0	<100	<50	--	--	--	--	310	51
629	08-14-84	Onl	13.5	<100	<50	56	29	2.6	1.7	206	11
633	08-23-84	Ꞓg	14.0	<100	<50	--	--	--	--	96	4.0
640	08-14-84	Ocl	13.0	370	<50	19	9.2	65	1.4	200	20
SP26	07-31-85	Onl	11.0	<10	<10	41	21	1.6	.59	164	7.0
SP27	08-01-85	Ꞓg	11.0	<10	<10	37	18	1.0	.64	152	5.0
Blair County											
150	06-04-80	Ꞓg	11.0	30	--	45	26	5.0	.3	250	3.0
223	06-10-80	Oba	11.5	30	--	60	36	1.7	.4	260	7.0
248	06-11-80	Onl	14.0	20	10	40	22	1.9	.9	190	7.0
254	06-16-80	Ꞓgm	14.0	340	30	48	3.6	1.2	.2	140	3.0
270	07-02-80	Oba	13.0	<10	--	78	43	2.2	1.0	320	2.0
272	07-02-80	Onl	11.0	130	--	46	26	.9	1.0	200	4.0
297	07-08-80	Onl	18.0	20	--	46	21	1.9	1.0	170	12
298	07-08-80	Oba	11.0	200	20	62	21	.8	1.0	250	4.0
361	07-09-80	Ocl	11.0	40	10	56	1.5	2.9	1.0	140	5.0
362	07-09-80	Ꞓg	11.0	170	10	50	20	1.7	1.0	220	5.0
390	08-21-84	Obf	11.0	<100	<50	63	38	2.1	1.1	236	12
394	07-21-84	Oba	12.5	210	<50	72	45	1.9	1.4	298	4.0
402	08-21-84	Ꞓg	13.0	280	<50	13	7.6	1.4	1.2	56	1.0
407	08-21-84	Ꞓg	14.0	<100	<50	--	--	---	--	130	3.0
423	08-20-84	Onl	13.0	210	<50	9.0	32	27	--	296	--
427	08-22-84	Oba	11.5	330	<50	--	--	---	--	204	7.0
430	08-20-84	Onl	11.5	<100	<50	64	42	3.1	1.3	274	10
437	08-22-84	Oba	12.0	300	120	--	--	---	--	314	470
444	08-20-84	Ꞓg	11.0	<100	<50	--	--	---	--	220	4.0
459	08-22-84	Ocl	12.0	<100	<50	--	--	---	--	238	21
465	08-22-84	Ꞓg	11.5	220	<50	--	--	---	--	68	1.0
479	08-21-84	Onl	11.0	750	90	--	--	---	--	170	7.0
485	08-22-84	Ocl	11.0	100	<50	--	--	---	--	220	10
491	08-22-84	Onl	11.0	<100	<50	--	--	---	--	224	10
608	06-13-85	Ocl	12.5	350	660	120	16	42	24	376	170
610	06-11-85	Ocl	11.5	<10	<10	140	6.8	3.4	2.2	306	19
615	06-13-85	Onl	11.0	<10	<10	60	34	1.0	1.0	238	14
619	06-11-85	Onl	11.5	<10	<10	--	--	--	--	248	66
SP12	08-01-85	Ꞓg	11.5	<10	<10	23	13	.34	<.13	122	2.0
SP17	08-01-85	Onl	11.0	<10	<10	34	17	1.3	.26	152	5.0
SP20	08-06-85	Obf	11.0	<10	<10	45	25	1.4	.55	194	8.0

Table 8.--Chemical analyses of major constituents in well and spring water--Continued

Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Nitrogen ammonia, dissolved (mg/L as N)	Nitrogen nitrite, dissolved (mg/L as N)	Nitrogen nitrate, dissolved (mg/L as N)	Phosphorus, ortho, dissolved (mg/L as P)	Hardness (mg/L as $CaCO_3$)	Solids, residue at 105 °C, dissolved (mg/L)	Specific conductance (µS/cm)	pH (standard units)	Date	County well or spring number
Bedford County											
30	<0.1	0.01	<0.01	10.0	--	390	570	600	7.40	08-20-80	310
25	<.1	.01	<.01	7.90	--	260	450	615	--	08-20-80	314
--	<.1	.01	<.01	0.08	--	180	300	--	--	08-21-80	317
30	.2	.01	<.01	1.50	--	170	248	365	6.80	08-27-80	389
10	<.1	.01	<.01	.04	--	240	254	455	7.30	09-18-80	489
29	.14	--	<.01	7.59	0.003	300	408	580	7.50	08-14-84	502
36	.14	--	<.01	3.27	.002	360	558	830	7.60	08-13-84	508
48	.18	--	<.01	17.1	.002	350	480	685	6.95	08-14-84	515
14	.1	--	<.01	3.29	.004	170	260	370	7.80	08-15-84	525
14	.1	--	<.01	9.00	.002	240	310	510	7.70	08-13-84	530
12	.22	--	<.001	2.05	.002	230	256	418	7.65	08-15-84	531
12	.1	--	<.01	3.63	.003	290	344	490	7.00	08-14-84	539
24	.22	--	<.01	1.73	.002	310	346	550	7.45	08-15-84	555
16	.1	--	<.01	3.77	.002	200	282	455	7.80	08-14-84	568
16	.12	--	<.01	6.70	.003	240	334	445	7.40	08-15-84	574
16	<.1	--	<.01	5.83	.004	--	256	360	7.90	08-23-84	592
29	<.1	--	<.01	4.18	.002	--	292	480	7.55	08-23-84	608
53	<.1	--	<.01	.12	.002	--	508	825	7.25	08-23-84	621
27	.14	--	<.01	8.57	.002	260	348	495	7.60	08-14-84	629
<10	<.1	--	<.01	3.19	.002	--	138	240	8.40	08-23-84	633
10	1.3	--	<.1	.034	.003	85	240	465	7.90	08-14-84	640
30	.1	--	<.001	5.06	<.002	190	268	360	7.80	07-31-85	SP26
28	.1	--	<.001	3.30	<.002	160	246	315	7.80	08-01-85	SP27
Blair County											
15	<.1	.01	<.01	2.60	--	220	306	509	--	06-04-80	150
30	.1	.02	<.01	5.10	--	300	380	605	--	06-10-80	223
10	<.1	.01	.034	6.40	--	190	280	450	--	06-11-80	248
5.0	<.1	.01	<.01	2.60	--	130	96	305	--	06-16-80	254
30	.3	.01	<.01	5.10	--	370	452	605	--	07-02-80	270
5.0	<.1	.01	<.01	5.70	--	220	308	435	--	07-02-80	272
20	<.1	.01	.01	8.80	--	200	264	427	7.10	07-08-80	297
40	<.1	.01	<.01	1.50	--	240	328	605	7.30	07-08-80	298
20	<.1	.01	<.01	2.60	--	150	182	335	7.20	07-09-80	361
20	<.1	.01	<.01	1.50	--	210	254	467	7.30	07-09-80	362
22	<.1	--	<.01	11.7	.002	320	390	600	7.70	08-21-84	390
40	<.1	--	<.01	4.95	.002	370	422	620	7.20	07-21-84	394
<10	<.1	--	<.01	.69	.002	64	96	125	8.60	08-21-84	402
<10	<.1	--	<.01	2.20	.004	--	176	270	8.20	08-21-84	407
67	.15	--	<.01	8.80	.002	150	518	845	7.23	08-20-84	423
22	<.1	--	<.01	7.15	.003	--	324	490	8.00	08-22-84	427
16	<.1	--	<.01	6.71	.002	330	426	700	7.60	08-20-84	430
71	<.1	--	<.01	100	.004	760	2,390	>1,000	6.40	08-22-84	437
10	<.1	--	<.01	4.18	.002	--	368	500	7.80	08-20-84	444
63	<.1	--	<.01	7.59	.002	--	464	720	7.40	08-22-84	459
<10	<.1	--	<.01	.88	.002	--	106	145	8.40	08-22-84	465
12	<.1	--	<.01	7.37	.003	--	272	410	7.62	08-21-84	479
22	<.1	--	<.01	7.81	.003	--	352	560	7.55	08-22-84	485
20	<.1	--	--	11.0	.002	--	358	550	7.90	08-22-84	491
60	.2	--	<.001	3.74	.006	370	758	>1,000	7.30	06-13-85	608
26	<.1	--	.004	12.3	.003	370	488	760	--	06-11-85	610
25	<.1	--	<.001	14.3	.003	290	398	625	7.40	06-13-85	615
24	<.1	--	<.001	17.6	.004	--	480	790	7.40	06-11-85	619
28	<.1	--	<1.00	.82	<.002	110	196	265	8.10	08-01-85	SP12
28	<.1	--	<.001	3.08	<.002	160	226	350	7.60	08-01-85	SP17
<10	<.1	--	<.001	7.70	.002	220	342	435	7.60	08-06-85	SP20

Table 8.--Chemical analyses of major constituents in well and spring water--Continued

County well or spring number	Date	Geologic unit^1	Temperature (°C)	Iron, dissolved (µg/L as Fe)	Manganese, dissolved (µg/L as Mn)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity, lab (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)
					Centre County						
238	07-16-80	Os	1.0	10	--	33	9.6	0.7	--	120	3.0
240	07-16-80	Os	1.5	220	--	52	20	1.0	--	200	8.0
247	08-06-80	Obl	--	--	<10	89	7.8	1.8	0.6	230	4.0
258	10-08-80	On	9.5	30	10	52	32	1.1	.9	250	4.0
291	10-22-80	Obf	--	10	<10	33	23	2.5	1.0	170	10
296	10-21-80	Obf	1.0	60	10	64	39	5.1	1.3	260	16
299	06-18-85	Oa	11.0	48	<10	67	29	4.5	1.5	250	21
358	10-23-80	Obf	11.0	10	10	63	29	3.1	1.0	250	11
372	11-05-80	Ocn	--	70	10	99	4.0	4.6	3.0	240	21
	06-26-85	Ocn	11.0	<10	<10	110	3.9	3.0	1.7	236	10
399	06-27-85	Ocn	11.0	<10	<10	140	14	3.4	.4	328	12
402	06-10-85	Ꞓgm	10.5	93	<10	61	19	15	.9	194	66
403	06-10-85	Os	1.0	240	<10	39	9.1	.3	.7	126	5.0
404	06-12-85	Ꞓgl	10.5	<10	<10	25	11	.5	.4	106	2.0
410	06-12-85	Ꞓgl	1.0	30	<10	69	24	13	.9	146	4.0
411	06-12-85	Ꞓgl	1.0	26	<10	32	12	7.4	.9	226	27
414	06-20-85	Oa	11.0	<10	<10	67	23	5.9	.3	240	17
418	06-20-85	Obf	11.0	51	<10	60	29	1.7	<.1	260	5.0
421	06-19-85	Os	11.0	150	<10	67	13	1.5	.3	202	6.0
426	06-19-85	Obf	11.0	140	<10	65	29	7.0	.2	160	66
438	06-12-85	On	11.0	<10	<10	65	35	13	1.2	246	42
447	06-20-85	Obf	11.0	1,100	<10	46	5.3	1.6	<.1	132	2.0
485	06-27-85	Obl	11.0	<10	<10	64	21	5.1	.6	232	18
487	06-25-85	Obl	10.5	<10	<10	120	25	7.8	1.1	308	23
494	06-27-85	Obf	10.5	<10	<10	70	36	12	.6	288	30
498	06-27-85	Ocn	12.0	43	<10	110	7.3	3.0	.5	282	9.0
509	06-25-85	Obl	10.5	<10	<10	62	25	1.0	.4	242	7.0
512	06-26-85	Obl	10.5	450	<10	79	4.3	9.2	.5	196	43
518	06-26-85	Ocn	11.0	23	<10	66	30	23	2.0	320	19
536	06-17-85	Obf	11.0	<10	<10	67	29	.8	.8	290	14
544	06-17-85	On	11.0	<10	<10	67	29	2.6	8.7	314	18
546	07-11-85	Oba	11.0	<10	<10	67	29	2.0	.3	292	8.0
555	06-24-85	On	12.0	22	<10	49	20	10	1.3	192	23
589	06-18-85	Obf	11.5	<10	<10	65	28	4.7	2.5	228	17
603	06-26-85	Obl	10.5	<10	<10	140	5.2	6.2	.8	342	14
609	06-18-85	Ꞓg	11.5	<10	<10	67	29	12	1.3	250	34
623	06-26-85	Ocn	1.0	<10	<10	20	1.9	.7	.5	58	2.0
632	06-25-85	Ꞓg	10.5	170	<10	37	22	1.2	.7	172	4.0
640	06-18-85	Obf	11.0	370	<10	67	29	1.4	.7	288	10
SP4	08-08-85	Obl	17.0	190	15	40	7.9	3.6	1.9	118	10
SP11	08-13-85	Obl	11.0	27	<10	65	12	4.4	.72	172	13
SP14	08-07-85	Obf	12.0	<10	<10	41	6.3	2.0	.53	110	6.0
SP17	08-08-85	On	12.0	<10	<10	67	31	4.3	.63	242	16
SP18	08-15-85	Ꞓgm	12.0	<10	<10	40	17	3.8	.63	156	14
SP19	08-08-85	On	12.0	<10	<10	29	14	3.3	.4	132	10
SP23	08-14-85	Obl	1.5	<10	<10	88	9.8	3.0	.78	232	11
SP24	08-15-85	Obl	11.5	<10	<10	74	18	2.1	.43	192	7.0
SP25	08-14-85	Ocn	11.0	<10	<10	50	6.2	1.5	.7	150	5.0
SP32	08-07-85	Ocn	12.0	<10	<10	57	19	1.5	.33	198	8.0
					Clinton County						
156	06-09-81	Obf	--	1	<1	36	15	5.1	.64	128	8.0
157	06-08-81	Obl	--	<1	<1	52	2.3	6.3	.5	124	5.0
159	06-08-81	Obl	--	<1	<1	45	4.7	6.5	.4	110	9.0
162	06-09-81	Obf	--	<1	<1	80	41	20	1.8	288	26
167	06-07-81	Obf	--	<1	<1	58	34	14	1.2	246	37
169	06-09-81	Obf	--	<1	<1	54	29	5.5	.64	230	6.0
172	06-10-81	Ocn	--	<1	<1	110	17	8.2	.58	308	6.0
277	06-16-81	Obl	--	<1	<1	35	13	3.6	1.0	130	14
283	06-17-81	Ocn	--	<1	<1	52	2.5	1.7	1.4	130	4.0
284	06-17-81	Ocn	--	<1	<1	100	4.1	10	.92	230	31

Table 8.--Chemical analyses of major constituents in well and spring water--Continued

Sulfate, dis- solved (mg/L as SO_4)	Fluo- ride, dis- solved (mg/L as F)	Nitro- gen ammonia, dis- solved (mg/L as N)	Nitro- gen nitrite, dis- solved (mg/L as N)	Nitro- gen nitrate, dis- solved (mg/L as N)	Phos- phorus, ortho, dis- solved (mg/L as P)	Hard- ness (mg/L as $CaCO_3$)	Solids, residue at 105 °C, dis- solved (mg/L)	Spe- cific con- duct- ance (µS/cm)	pH (stand- ard units)	Date	County well or spring number
					Centre County						
10	<0.1	0.02	<0.01	4.00	--	120	226	290	7.70	07-16-80	238
20	<.1	.01	<.01	5.10	--	210	342	420	7.80	07-16-80	240
25	.1	.01	<.01	2.80	--	250	314	390	7.50	08-06-80	247
10	<.1	.01	<.01	1.90	--	260	232	310	7.40	10-08-80	258
10	.2	.01	<.01	2.00	--	180	248	430	7.40	10-22-80	291
15	.3	.01	<.01	5.90	--	320	374	650	7.70	10-21-80	296
32	.2	--	<.001	6.60	0.003	290	440	610	7.50	06-18-85	299
15	.1	.01	<.01	3.10	--	280	302	590	7.70	10-23-80	358
20	.2	.04	<.01	8.40	--	260	400	565	7.70	11-05-80	372
36	.1	--	<.001	7.30	.025	300	376	580	7.10	06-26-85	
68	<.1	--	<.001	6.80	.007	400	484	780	7.10	06-27-85	399
<10	<.1	--	<.001	10.3	.003	230	406	640	7.40	06-10-85	402
<10	.1	--	<.001	8.40	.003	140	196	320	8.50	06-10-85	403
<10	<.1	--	<.001	2.90	.002	110	148	250	8.20	06-12-85	404
<10	.1	--	<.001	1.40	.002	270	184	308	7.90	06-12-85	410
17	<.1	--	<.001	5.50	.002	130	348	565	7.50	06-12-85	411
31	.1	--	<.001	3.50	.002	260	380	575	7.50	06-20-85	414
27	.2	--	<.001	1.30	.002	270	410	515	7.40	06-20-85	418
28	<.1	--	<.001	3.50	<.002	220	310	455	7.50	06-19-85	421
59	.1	--	<.001	1.50	<.002	280	516	620	7.70	06-19-85	426
37	.1	--	<.001	5.06	.003	300	434	670	7.50	06-12-85	438
22	.1	--	<.001	1.10	.002	140	200	285	7.70	06-20-85	447
35	.1	--	<.001	5.50	.006	250	428	560	7.40	06-27-85	485
31	<.1	--	<.001	5.70	.006	400	444	725	7.10	06-25-85	487
38	.1	--	<.001	3.70	.005	330	440	690	7.30	06-27-85	494
58	.1	--	<.001	2.30	.007	300	420	625	7.10	06-27-85	498
35	.2	--	<.001	4.80	.006	260	334	515	7.50	06-25-85	509
28	<.1	--	<.001	1.40	.007	210	376	480	7.30	06-26-85	512
37	.4	--	<.001	<0.04	.01	290	408	660	7.30	06-26-85	518
98	.2	--	<.001	.70	.003	290	536	665	7.40	06-17-85	536
26	<.1	--	<.001	12.7	.003	290	524	750	7.20	06-17-85	544
30	.1	--	<.001	7.50	.007	290	450	540	7.20	07-11-85	546
35	<.1	--	<.001	5.70	.008	200	328	515	7.50	06-24-85	555
33	.2	--	<.001	4.40	<.002	280	382	540	7.70	06-18-85	589
32	<.1	--	<.001	9.90	.036	380	468	750	6.80	06-26-85	603
38	.2	--	<.001	7.00	.002	290	482	670	7.40	06-18-85	609
18	<.1	--	<.001	.40	.007	57	82	123	8.00	06-26-85	623
16	<.1	--	<.001	1.90	.005	180	230	360	7.50	06-25-85	632
50	.2	--	<.001	7.90	<.002	290	550	660	7.50	06-18-85	640
<10	<.1	--	<.001	1.76	.019	130	256	305	7.60	08-08-85	SP4
26	<.1	--	<.001	5.46	.002	210	274	450	7.50	08-13-85	SP11
<10	<.1	--	<.001	3.74	.003	130	218	290	7.40	08-07-85	SP14
28	<.1	--	<.001	7.92	.002	290	252	600	7.40	08-08-85	SP17
<10	<.1	--	<.001	4.20	.004	170	218	395	7.50	08-15-85	SP18
<10	<.1	--	<.001	1.88	.002	130	452	310	8.00	08-08-85	SP19
11	<.1	--	.001	5.72	.002	260	352	525	7.10	08-14-85	SP23
57	.17	--	<.001	2.86	.004	260	308	525	7.40	08-15-85	SP24
<10	<.1	--	<.001	3.74	.003	150	184	345	7.50	08-14-85	SP25
<10	<.1	--	<.001	5.06	.002	220	366	475	7.60	08-07-85	SP32
					Clinton County						
20	<.1	.08	.002	1.44	--	150	240	--	--	06-09-81	156
5.0	<.1	.01	.002	5.06	--	140	220	--	--	06-08-81	157
5.0	<.1	.08	.002	3.74	--	130	200	--	--	06-08-81	159
45	<.1	.08	.002	26.5	--	370	580	--	--	06-09-81	162
25	<.1	.08	.002	3.96	--	290	438	--	--	06-07-81	167
25	<.1	.08	.002	3.08	--	250	322	--	--	06-09-81	169
60	<.1	.13	.02	.94	--	340	464	--	--	06-10-81	172
10	<.1	.01	.002	1.32	--	140	222	--	--	06-16-81	277
9.0	<.1	.01	.004	4.18	--	140	176	--	--	06-17-81	283
13	<.1	.01	.002	4.18	--	270	378	--	--	06-17-81	284

Table 8.--Chemical analyses of major constituents in well and spring water--Continued

County well or spring number	Date	Geologic unit[1]	Temperature (°C)	Iron, dissolved (μg/L as Fe)	Manganese, dissolved (μg/L as Mn)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity lab (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)
					Clinton County--Continued						
285	06-17-81	Obf	--	<1	<1	69	30	1.1	0.8	256	4.0
297	06-23-81	Ocn	--	<1	<1	65	3.6	5.6	1.0	150	8.0
298	06-23-81	Obl	--	1	<1	38	11	0.6	.52	128	2.0
353	06-25-85	Obl	1.5	31	<10	35	2.7	4.9	1.0	100	21
354	06-25-85	Obf	11.5	<10	<10	66	37	7.0	2.2	274	19
359	06-25-85	Obf	12.5	<10	<10	130	6.7	6.8	.7	314	22
375	06-24-85	Obf	12.0	<10	14	54	28	8.9	49	418	68
376	06-25-85	Oa	13.0	25	<10	29	17	.5	.7	154	4.0
SP2	08-13-85	Obf	15.0	34	<10	35	11	2.9	.66	114	9.0
SP12	08-12-85	Oa-Obf	13.0	<10	<10	30	14	.99	.54	124	4.0
SP17	08-14-85	Och	14.0	<10	<10	36	10	3.2	.5	118	10
SP21	08-14-85	Obl	14.0	<10	<10	40	12	3.5	.54	126	11
					Huntingdon County						
119	06-05-80	On	--	110	10	35	20	4.5	.4	180	2.0
200	07-15-80	Os	14.0	10	--	41	23	4.5	--	180	8.0
263	07-16-80	Ocl	14.0	190	10	36	22	29	--	260	16
275	06-17-85	Os	1.0	<10	<10	56	20	1.1	.8	192	6.0
350	06-19-85	Cgl	1.5	1,300	<10	42	23	1.6	.2	186	6.0
357	06-19-85	On	1.0	86	<10	49	27	1.0	1.4	198	10
394	06-11-85	Oba	13.5	<10	<10	46	28	1.2	1.0	206	6.0
SP1	08-06-85	Obf	12.0	82	28	28	16	1.0	.48	124	4.0
SP2	08-09-85	Cgm	11.0	<10	<10	33	17	.59	.43	142	3.0
SP13	08-09-85	Obl	12.0	<10	10	60	4.3	1.5	.68	146	5.0
					Mifflin County						
241	07-23-80	Obf	15.0	20	--	58	28	6.4	1.0	200	20
272	07-19-84	Obf	14.0	2,700	500	96	36	26	4.9	348	42
273	07-16-84	Obf	12.0	100	<50	71	28	27	3.1	226	41
275	07-30-80	Obf	13.0	30	20	76	35	7.5	2.0	350	24
321	07-17-84	Obf	13.0	<100	<100	58	31	.7	1.3	234	5.0
329	07-23-84	Obl	11.5	1,500	<50	89	17	2.9	.9	226	5.0
339	07-23-84	Obf	11.5	<100	<50	66	35	6.3	1.4	232	19
349	07-17-84	Obf	12.0	<100	<100	86	34	13	6.3	266	30
353	07-18-84	Ocn	12.0	100	<100	90	7.4	1.2	.5	238	3.0
362	07-17-84	Obl	13.5	<100	<100	78	28	4.9	1.1	248	13
367	07-17-84	Obl	12.0	300	300	120	7.7	34	1.0	260	94
389	07-18-84	Obf	11.5	<100	<100	87	48	4.1	2.8	332	10
394	07-18-84	Obl	13.0	100	100	150	17	9.8	5.4	362	34
SP2	08-22-85	Oa	11.0	120	<10	71	0.8	2.0	.82	194	9.0
SP3	08-22-85	Obl	16.5	210	19	34	.8	1.5	.76	86	8.0

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[1] Och: Coburn, Salona, and Nealmont Formations; Obl: Benner, Snyder, Hatter, and Loysburg Formations; Ocl: Coburn through Loysburg Formations; Obf: Bellefonte Formation; Oa: Axemann Formation; Oba: Bellefonte and Axemann Formations; On: Nittany Formation; Onl: Nittany and Larke Formations; Os: Stonehenge Formation; Cg: Gatesburg Formation; Cgm: Mines Member of Gatesburg Formation; Cgl: lower members of Gatesburg Formation; Cw: Warrior Formation

Table 8.--Chemical analyses of major constituents in well and spring water--Continued

Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Nitrogen, ammonia dissolved (mg/L as N)	Nitrogen, nitrite dissolved (mg/L as N)	Nitrogen, nitrate dissolved (mg/L as N)	Phosphorus, ortho, dissolved (mg/L as P)	Hardness (mg/L as $CaCO_3$)	Solids, residue at 105 °C, dissolved (mg/L)	Specific conductance (µS/cm)	pH (standard units)	Date	County well or spring number
					Clinton County--Continued						
33	0.1	0.01	0.002	0.16	--	290	346	--	--	06-17-81	285
5.0	.13	.08	.002	5.94	--	180	240	--	--	06-23-81	297
5.0	.1	.01	.002	.32	--	140	174	--	--	06-23-81	298
13	<.1	--	<.001	3.50	0.006	99	216	295	7.50	06-25-85	353
41	<.1	--	<.001	14.3	.006	320	540	705	7.20	06-25-85	354
33	.1	--	<.001	8.10	.008	340	484	725	7.00	06-25-85	359
77	<.1	--	<.001	18.3	.015	250	776	>1,000	7.00	06-24-85	375
13	<.1	--	<.001	2.50	.007	150	194	320	7.90	06-25-85	376
11	<.1	--	<.001	1.88	.002	130	172	290	7.70	08-13-85	SP2
<10	<.1	--	<.001	1.76	.003	130	154	275	8.00	08-12-85	SP12
14	<.1	--	<.001	2.64	.002	130	180	315	7.80	08-14-85	SP17
14	<.1	--	<.001	3.30	.002	150	202	350	7.70	08-14-85	SP21
					Huntingdon County						
20	<.1	.01	<.01	1.60	--	170	204	--	--	06-05-80	119
10	<.1	.02	<.01	7.60	--	200	248	320	--	07-15-80	200
30	1.5	1.70	<.01	.01	--	180	406	420	8.90	07-16-80	263
20	.1	--	<.001	5.50	.002	220	280	415	7.60	06-17-85	275
23	.1	--	<.001	5.30	<.002	200	290	400	7.70	06-19-85	350
22	<.1	--	<.001	6.80	.002	230	358	450	7.60	06-19-85	357
17	<.1	--	<.001	9.00	.003	230	298	480	7.50	06-11-85	394
<10	<.1	--	<.001	2.86	.003	130	256	280	7.90	08-06-85	SP1
<10	<.1	--	<.001	3.74	.002	150	268	157	7.80	08-09-85	SP2
14	<.1	--	<.001	4.40	.02	170	304	360	7.40	08-09-85	SP13
					Mifflin County						
20	<.1	.02	<.01	.066	--	260	--	480	7.20	07-23-80	241
50	.08	--	<.01	--	.009	390	506	920	6.90	07-19-84	272
75	.08	--	<.01	3.60	.18	290	478	650	7.30	07-16-84	273
30	.5	.01	<.01	8.40	--	330	536	810	--	07-30-80	275
33	.14	--	.01	3.72	.002	270	336	530	7.20	07-17-84	321
85	.01	--	<.01	1.75	.001	290	368	520	7.80	07-23-84	329
43	<.01	--	<.01	11.0	<.001	310	424	560	7.40	07-23-84	339
63	.1	--	<.01	15.1	.002	360	568	745	7.00	07-17-84	349
50	.07	--	<.01	4.18	.003	250	364	510	7.20	07-18-84	353
55	.2	--	<.01	1.8	.006	310	484	615	6.90	07-17-84	362
50	.08	--	<.01	11.9	.003	340	642	790	6.80	07-17-84	367
63	.09	--	<.01	9.90	.015	410	552	710	7.40	07-18-84	389
70	.09	--	<.01	8.14	.008	430	614	845	6.90	07-18-84	394
20	<.1	--	<.001	7.55	.01	180	298	460	7.70	08-22-85	SP2
12	<.1	--	<.001	.95	.006	89	132	215	7.80	08-22-85	SP3

Table 9.--Summary of statistics on the concentrations of major chemical constituents in water from selected geologic units

[µg/L, micrograms per liter; mg/L, milligrams per liter; Max, maximum; Min, minimum; Med, median]

Geologic unit	Range in number of samples (range)	Constituent																	
		Iron (µg/L)			Manganese (µg/L)			Calcium (mg/L)			Magnesium (mg/L)			Sodium (mg/L)			Potassium (mg/L)		
		Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med
Coburn through Nealmont Formations, undivided	15	190	1	5	50	1	10	140	20	65	30	1.9	7.3	23	0.7	3.2	3	0.3	0.7
Benner through Loysburg Formations, undivided	20-21	1,500	1	5	300	1	10	150	35	65	28	0.7	11	34	.6	4.4	5.4	.4	.7
Coburn through Loysburg Formations, undivided	7-10	370	5	75	660	10	25	140	19	70	35	1.5	9.2	65	2.9	7.9	24	.8	1
Coburn through Loysburg Formations, (All)^1	43-46	1,500	1	5	660	1	10	150	19	66	35	.7	7.9	65	.6	3.6	24	.3	.8
Bellefonte Formation	33-34	2,700	1	32	500	1	10	130	28	63	48	5.3	29	27	.7	4.9	49	.1	1
Axemann Formation	4	120	5	36	10	5	5	71	29	67	29	.8	20	5.9	.5	3.2	1.5	.3	.8
Bellefonte, Axemann Formations, undivided	9-12	330	5	30	120	10	15	96	30	67	45	14	29	25	.8	1.9	5.7	.3	1
Bellefonte, Axemann Formations, (All)^1	46-50	2,700	1	30	500	1	10	130	28	64	48	.8	29	27	.5	3.1	49	.1	1
Nittany Formation	7	86	5	5	10	5	10	67	29	52	35	14	29	13	1	3.3	8.7	.4	1
Nittany, Larke Formations, undivided	12-16	750	5	50	90	10	25	73	9	46	42	17	26	48	.9	2.2	2.1	.3	1
Stonehenge Formation	3-6	240	5	80	10	5	5	67	33	47	23	91	17	4.5	.3	1.1	0.7	.2	.3
Gatesburg Formation, undivided	10-15	280	5	50	25	5	18	69	13	43	33	7.6	21	12	.3	1.2	1.3	.1	.9
Gatesburg Formation, (All)^1	18-23	1,300	5	50	30	5	10	69	13	41	33	3.6	19	15	.3	1.3	1.4	.1	.9

Table 9.--Summary of statistics on the concentrations of major chemical constituents in water from selected geologic units--Continued

[μg/L, micrograms per liter; mg/L, milligrams per liter; Max, maximum; Min, minumum; Med, median]

Geologic unit	Range in number of samples (range)	Constituent														
		Chloride (mg/L)			Sulfate (mg/L)			Nitrate, as N (mg/L)			Alkalinity, as $CaCO_3$ (mg/L)			Dissolved solids (mg/L)		
		Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med
Coburn-Nealmont Formations, undivided	15	31	2	9	68	5	18	8.4	0.02	4.2	328	58	230	484	82	366
Benner-Loysburg Formations, undivided	20-21	94	2	11	85	5	26	11.9	.3	3.7	362	86	196	642	132	314
Coburn-Loysburg Formations, undivided	7-10	170	5	18	63	10	21	17.1	.03	5.7	376	124	220	758	182	317
Coburn-Loysburg Formations (All)[1]	43-46	170	2	11	85	5	21	17.1	.02	4.2	376	58	194	758	82	343
Bellefonte Formation	33-34	68	1	12	98	5	30	27	.06	4.4	418	110	246	776	130	399
Axemann Formation	4	21	4	13	32	13	26	7.6	2.5	5	250	124	194	440	194	339
Bellefonte, Axemann Formations, undivided	9-12	470	2	7	71	5	30	100	.12	5.1	360	204	292	2,390	154	436
Bellefonte, Axemann Formations, (All)[1]	46-50	470	1	10	98	5	30	100	.06	5.0	418	110	250	2,390	130	399
Nittany Formation	7	42	4	16	37	5	26	12.7	1.8	5.7	314	132	242	524	232	328
Nittany, Larke Formations, undivided	12-16	110	2	7.2	67	5	20	17.6	1.6	6.6	296	152	203	558	204	326
Stonehenge Formation	3-6	8	3	6	28	5	15	8.4	3.5	7.8	202	120	186	342	196	269
Gatesburg Formation, undivided	10-15	34	1	4	38	5	16	7	.04	1.9	284	56	190	482	96	248
Gatesburg Formation, (All)[1]	18-23	66	1	4	38	5	15	10	.04	2.6	284	56	172	482	96	247

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[1] Includes formations mapped separately and those mapped as one unit.

[2] Medians include value reported at less than a detection limit.

Iron and Manganese

The concentration of iron exceeds the USEPA's SMCL of 300 μg/L (0.3 mg/L) in 12 of 148 sample analyses. Manganese concentrations exceed the SMCL of 50 μg/L (0.05 mg/L) in 6 of 141 samples analyzed. Iron and manganese are similar geochemically in the ground-water environment. They are leached from rock and soil under acidic conditions, but iron also is commonly stripped from pipes in water-distribution systems. Although not toxic at SMCL levels, both impart an unpleasant taste to water and stain clothing, dishes, and porcelain. Concentrations in most samples that exceed SMCLs exceed them only slightly. One of the four samples that greatly exceeded the SMCL for iron is from a well that is contaminated by a leaking gasoline tank (Mf 272). Water from soil that has been leached by gasoline is known to contain elevated levels of iron and manganese (Becher and Root, 1981). Of the remaining samples, two (Ce 447, Cn 350) are from wells on the flank of a mountain ridge and probably receive iron dissolved by acidic water percolating through sandstone. Iron in the fourth sample (Mf 329) is of local origin and may be coming from a water-distribution system.

Dissolved solids

Nineteen of the 146 samples analyzed contained dissolved solids greater than the 500 mg/L SMCL recommended by the USEPA (1977b). Elevated concentrations do not pose any health problems and are acceptable if water with dissolved-solid concentrations that meet the SMCL is not available. Most samples containing elevated concentrations of dissolved solids also have elevated concentrations of chloride, sulfate, and nitrate. A few samples were from wells known to have been contaminated by gasoline or pesticides. The average dissolved-solids concentration in natural water in carbonate rocks of these valleys probably is slightly less than 400 mg/L. Therefore, little additional mineral matter need be dissolved to increase the total above the SMCL for dissolved solids.

Nitrate

Elevated concentrations of nitrate in ground water of agricultural areas are largely caused by fertilizers, although septic tank effluents upgradient from wells may also be contributors. Concentrations of nitrate in 17 of 146 sample analyses exceed the MCL of 10 mg/L (nitrate as N) for drinking water. Water from the Gatesburg Formation has the lowest concentration of nitrate; the median is 2 mg/L. Gatesburg Formation terrane also has the least amount of cropland. The median values of all other geologic units range from a low of 3.7 in the Coburn through Nealmont Formations (carbonate unit bordering the noncarbonate terrane) to a high of 7.1 mg/L in the undivided Bellefonte and Axemann Formations. Ground-water from Kishacoquillas Valley has the highest nitrate concentration of all the valleys. The median here is 5.9 mg/L, but 25 percent of the samples have nitrate concentrations that exceeded 10 mg/L. Median nitrate concentrations for the southern part of the Nittany Valley (south of the Huntingdon-Centre County line) and the Morrison Cove and Canoe Valley are 5.3 and 4.9 mg/L, respectively. In contrast, the median concentration of nitrate in the northern part of the Nittany, Penns, Brush, and Sugar Valleys combined is only 3.3 mg/L. The median concentration of nitrate in Snake Spring Valley is only 3.8 mg/L.

Trace Elements

Ground-water samples were analyzed for selected elements, normally found in trace amounts only, to determine natural concentrations and areas of anomalously elevated concentrations. Of the 122 trace-element analyses shown in table 10, 41 were for samples collected in 1980 and 1981 for an earlier study (Taylor and others, 1982) and 81 were for samples collected during this study. The metals selected for analysis are arsenic, barium, cadmium, chromium, lead, nickel, strontium, zinc, and aluminum.

None of the samples contained concentrations in excess of the MCL set by the USEPA (1986a) of 1,000 μg/L for barium and 10 μg/L for cadmium. The concentration of lead in one sample slightly exceeds the MCL of 50 μg/L. Although no health-related standards exist for strontium and aluminum, a concentration of 2,500 μg/L of strontium was found in one sample and a concentration of 2,500 μg/L of aluminum in another sample. The recommended SMCL (USEPA, 1986b) of 5,000 μg/L for zinc was exceeded in one sample. Arsenic and chromium were not found in concentrations that exceed the USEPA MCL of 50 μg/L (1986a). Some concentrations were reported as <500 or <1,000 μg/L for arsenic and <70 μg/L for chromium because of the detection limits of the laboratory equipment used.

Zinc and lead were not detected in water from the two wells (Ba 608 and 610) near the southern end of the Nittany Valley, where noneconomic deposits of these metals have been found (R.C. Smith, 1977). A detailed study, based on more extensive sampling, both areally and temporally (Cravotta, 1986), revealed low levels of zinc and lead, well below the MCLs for these metals in potable water, in all water samples.

Table 10.--Chemical analyses of trace metals in well and spring water
[µg/L, micrograms per liter; <, less than; --, no data]

County well or spring number	Date	Geologic unit[1]	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Lead, dissolved (µg/L as Pb)	Nickel, dissolved (µg/L as Ni)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)	Aluminum, dissolved (µg/L as Al)
						Bedford County					
310	08-20-80	Oba	--	--	--	50	--	20	--	10	40
314	08-20-80	Oba	--	--	--	40	--	10	--	20	40
317	08-21-80	Ꞓw	--	--	--	50	--	--	--	10	30
389	08-27-80	Ꞓg	--	--	--	--	--	10	--	620	30
489	09-18-80	Ꞓg	<1	--	--	10	--	10	--	20	30
508	08-13-84	Ons	<4	110	<1	<70	28	<140	70	70	<100
515	08-14-84	Ocn	<4	70	1	<70	21	<140	110	70	100
531	08-15-84	Ꞓw	<4	230	<1	<70	<4	<140	50	10	100
555	08-15-84	Ꞓg	<4	300	<1	<70	8	<140	50	780	100
608	08-23-84	Ꞓg	--	200	--	<70	--	<140	330	950	100
SP26	07-31-85	Ons	<1,000	39	<10	<50	<45	<25	<10	<10	<40
SP27	08-01-85	Ꞓg	<1,000	41	<10	<50	<45	<25	<10	<10	<40
						Blair County					
150	06-04-80	Ꞓg	--	--	--	10	--	--	--	890	20
223	06-10-80	Oba	--	--	--	--	--	--	--	20	<10
248	06-11-80	Ons	--	--	--	--	--	10	--	610	20
254	06-16-80	Ꞓgm	--	--	--	--	--	--	--	130	100
270	07-02-80	Oba	--	--	3	--	--	--	--	6,000	30
272	07-02-80	Ons	--	--	--	--	--	--	--	<10	20
297	07-08-80	Ons	--	--	--	--	--	--	--	280	40
298	07-08-80	Oba	--	--	--	--	--	--	--	1,400	30
361	07-09-80	Ocl	--	--	--	--	--	10	--	120	20
362	07-09-80	Ꞓg	--	--	--	10	--	10	--	10	30
402	08-21-84	Ꞓg	<4	<60	<1	<70	5	<140	<10	200	<100
423	08-20-84	Ons	<4	80	<1	<70	4	<140	150	40	100
437	08-22-84	Oba	--	140	--	<70	--	<140	220	30	100
444	08-20-84	Ꞓg	<4	<60	<1	<70	<4	<140	20	20	<100
465	08-22-84	Ꞓg	--	<60	--	<70	--	<140	10	10	100
479	08-21-84	Ons	<4	60	3	<70	31	<140	40	150	200
608	06-13-85	Ocl	<500	150	<10	<50	<45	<25	<10	68	<40
610	06-11-85	Ocl	<500	45	<10	<50	<45	<25	<10	<10	<40
615	06-13-85	Ons	<500	28	<10	<4	<45	<25	<10	<10	<40
619	06-11-85	Ons	<500	10	<10	<50	<45	<25	<10	<10	<40
SP12	08-01-85	Ꞓg	<1,000	14	<10	<50	<45	<25	<10	<10	<40
SP17	08-01-85	On	<1,000	22	<10	<50	<45	<25	<10	<10	<40
SP20	08-06-85	Obf	<1,000	26	<10	<50	<45	<25	<10	<10	<40
						Centre County					
238	07-16-80	Os	--	--	--	--	--	--	--	15	10
240	07-16-80	Os	--	--	--	--	--	--	--	30	10
247	08-06-80	Obl	<10	--	<3	10	<50	<10	--	30	60
258	10-08-80	On	--	--	<1	--	--	--	--	<10	60
291	10-22-80	Obf	<5	--	<1	<10	<5	20	--	10	80
296	10-21-80	Obf	--	--	<1	--	--	20	--	140	--
299	06-18-85	Oa	<500	53	<10	<50	<45	<25	<10	<10	<40
358	10-23-80	Obf	--	--	<1	--	--	--	--	30	80
372	11-05-80	Ocn	<5	--	<1	<10	<5	10	--	90	90
372	06-26-85	Ocn	<500	33	<10	<50	<45	<25	170	40	<40
399	06-27-85	Ocn	<500	81	<10	<50	<45	<25	480	<10	<40
402	06-10-85	Ꞓgm	<500	22	<10	<50	<45	<25	<10	<10	<40
403	06-10-85	Os	<500	16	<10	<50	<45	<25	<10	<10	<40
404	06-12-85	Ꞓgl	<500	23	<10	<50	<45	<25	<10	<10	<40
410	06-12-85	Ꞓgl	<500	65	10	<50	<45	<25	<10	<10	<40
411	06-12-85	Ꞓgl	9	63	3	<50	17	43	<10	24	<40
414	06-20-85	Oa	<500	47	<10	<50	<45	<25	<10	<10	<40
418	06-20-85	Obf	<500	53	<10	<50	<45	<25	<10	<10	<40
421	06-19-85	Os	<500	12	<10	<50	<45	<25	<10	<10	<40
426	06-19-85	Obf	<500	67	<10	<50	<45	<25	<10	<10	<40
438	06-12-85	On	<500	30	<10	<50	<45	<25	<10	<10	<40
447	06-20-85	Obf	<500	26	<10	<50	<45	<25	<10	<10	<40
485	06-27-85	Obl	<500	51	<10	<50	<45	<25	220	<10	<40
487	06-25-85	Obl	<500	90	<10	<50	<45	<24	320	<10	<40
494	06-27-85	Obf	<500	83	<10	<50	<45	<25	440	<10	<40
498	06-27-85	Ocn	<500	89	10	<50	<45	<25	490	17	<40
509	06-25-85	Obl	<500	45	<10	<50	<45	<25	290	<10	<40

Table 10.--Chemical analyses of trace metals in well and spring water--Continued
[µg/L, micrograms per liter; <, less than; --, no data]

County well or spring number	Date	Geologic unit[1]	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Lead, dissolved (µg/L as Pb)	Nickel, dissolved (µg/L as Ni)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)	Aluminum, dissolved (µg/L as Al)
					Centre County--Continued						
512	06-26-85	Obl	<500	30	<10	<50	<45	<25	150	<10	<40
518	06-26-85	Ocn	<500	310	<10	<50	<45	<25	2,500	43	<40
536	06-17-85	Obf	<500	45	<10	<50	<45	<25	<10	28	<40
544	06-17-85	On	<500	49	<10	<50	<45	<25	<10	<10	<40
546	07-11-85	Oba	<500	32	<10	<50	<45	<25	<10	<10	<40
555	06-24-85	On	<500	41	<10	<50	<45	<25	25	12	<40
589	06-18-85	Obf	<500	66	<10	<50	<45	<25	<10	<10	<40
603	06-26-85	Obl	<500	54	<10	<50	<45	<25	120	<10	210
609	06-18-85	Cg	<500	20	<10	<50	<45	<25	<10	15	<40
623	06-26-85	Ocn	<500	16	<10	<50	<45	<25	140	<10	<40
632	06-25-85	Cg	<500	14	<10	<50	<45	<25	<10	<10	<40
640	06-18-85	Obf	<500	33	<10	<50	<45	<25	<10	29	<40
SP4	08-08-85	Obl	<1,000	38	<10	<50	<45	<25	41	<10	650
SP11	08-13-85	Obl	<1,000	48	<10	<50	<45	<25	210	<10	<40
SP14	08-07-85	Cg	<1,000	42	<10	<50	<45	<25	38	<10	<40
SP17	08-08-85	On	<1,000	32	<10	<50	<45	<25	31	<10	<40
SP18	08-15-85	Cgm	<1,000	22	<10	<50	<45	<25	<10	<10	<40
SP19	08-08-85	On	<1,000	23	<10	<50	<45	<25	<10	<10	<40
SP23	08-14-85	Obl	<1,000	37	<10	<50	<45	<25	230	<10	<40
SP24	08-15-85	Obl	<1,000	36	<10	<50	<45	<25	860	<10	<40
SP25	08-14-85	Ocn	<1,000	32	<10	<50	<45	<25	110	<10	<40
SP32	08-07-85	Ocn	<1,000	39	<10	<50	<45	<25	87	<10	<40
					Clinton County						
156	06-09-81	Obf	<1	--	<1	<1	<1	<1	--	<1	<1
157	06-08-81	Obl	<1	--	<1	<1	<1	<1	--	<1	<1
159	06-08-81	Obl	<1	--	<1	<1	<1	<1	--	1	<1
162	06-09-81	Obf	<1	--	<1	<1	<1	<1	--	<1	<1
167	06-07-81	Obf	<1	--	<1	<1	<1	<1	--	1	<1
169	06-09-81	Obf	<1	--	<1	<1	<1	<1	--	<1	<1
172	06-10-81	Ocn	<1	--	<1	<1	<1	<1	--	<1	<1
277	06-16-81	Obl	<1	--	<1	<1	<1	<1	--	<1	<1
283	06-17-81	Ocn	<1	--	<1	<1	<1	<1	--	<1	<1
284	06-17-81	Ocn	<1	--	<1	<1	<1	<1	--	<1	<1
285	06-17-81	Obf	<1	--	<1	<1	<1	<1	--	<1	<1
297	06-23-81	Ocn	<1	--	<1	<1	<1	<1	--	1	<1
298	06-23-81	Obl	<1	--	<1	<1	<1	<1	--	<1	<1
353	06-25-85	Obl	<500	27	<10	<50	<45	<25	<10	<10	<40
354	06-25-85	Obf	<500	78	<10	<50	<45	<25	110	<10	<40
359	06-25-85	Obf	<500	49	<10	<50	<45	<25	100	<10	<40
375	06-24-85	Obf	<500	60	<10	<50	59	<25	12	24	<40
376	06-25-85	Oa	<500	26	<10	<50	<45	<25	<10	340	<40
SP2	08-13-85	Obf	<1,000	38	<10	<50	<45	<25	110	<10	<40
SP12	08-12-85	Ꞓph	<1,000	27	<10	<50	<45	<25	<10	<10	<40
SP17	08-14-85	Ꞓph	<1,000	31	<10	<50	<45	<25	140	<10	<40
SP21	08-14-85	Obl	<1,000	35	<10	<50	<45	<25	170	<10	<40
					Huntingdon County						
119	06-05-80	On	--	--	--	--	--	20	--	100	50
200	07-15-80	Os	--	--	--	--	--	--	--	450	40
263	07-16-80	Ocl	--	--	--	--	--	--	--	10	70
275	06-17-85	Os	<500	21	<10	<50	<45	<25	<10	<10	<40
350	06-19-85	Ꞓgl	<500	16	<10	<50	<45	<25	<10	390	<40
357	06-19-85	On	<500	15	<10	<50	<45	<25	<10	<10	<40
394	06-11-85	Oba	<500	19	<10	<50	<45	<25	<10	240	<40
SP1	08-06-85	Obf	<1,000	57	<10	<50	<45	<25	11	<10	<40
SP2	08-09-85	On	<1,000	19	<10	<50	<45	<25	<10	<10	<40
SP13	08-09-85	Obl	<1,000	39	<10	<50	<45	<25	48	<10	40
					Mifflin County						
241	07-23-80	Obf	--	--	--	20	--	--	--	10	<10
273	07-16-84	Obf	<4	70	<10	<70	<4	<140	130	80	<100
275	07-30-80	Obf	--	--	--	110	--	--	--	30	50
329	07-23-84	Obl	<4	<60	<10	<70	8	<140	280	20	2,500
SP2	08-22-85	Oa	<1,000	45	<10	<50	<45	<25	<10	<10	<40
SP3	08-22-85	Ocn	<1,000	33	<10	<50	<45	<25	<10	<10	180

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[1] Och: Coburn, Salona, and Nealmont Formations; Obl: Benner, Snyder, Hatter, and Loysburg Formations; Ocl: Coburn through Loysburg Formations; Obf: Bellefonte Formation; Oa: Axemann Formation; Oba: Bellefonte and Axemann Formations; On: Nittany Formation; Ons: Nittany and Larke Formations; Os: Stonehenge Formation; Cg: Gatesburg Formation; Ꞓgm: Mines Member of Gatesburg Formation; Ꞓgl: lower members of Gatesburg Formation; Ꞓw: Warrior Formation; Ꞓph: Pleasant Hill Formation.

Herbicides

Ground-water samples were analyzed for organic compounds that are commonly used to control weeds in crop areas of these valleys. These compounds are in a group of related organic chemicals generally called herbicides. They include propazine, simazine, metolachlor, toxaphene, atrazine, alachlor, and cyanazine. All of these chemicals were designed to be biodegradable in the environment, to prevent harm to lifeforms other than the pests to be controlled, and to avoid contamination of water resources.

The laboratory results from 10 wells and from 10 of the larger springs are reported in table 11. All of the samples were collected during the summer after the pesticides were applied and residues conceivably could have percolated into the ground water. Only simazine, atrazine, and alachlor were found in samples. No standards for drinking water have been established by the USEPA for these pesticides, but it is worthwhile to report their common occurrence in ground water. Four of the wells sampled contained simazine, five contained atrazine, and three contained alachlor. Water from two springs contained atrazine but no other herbicide. The exceptionally elevated concentrations of atrazine (11 μg/L) and alachlor (20 μg/L) in water from well Ba 437 probably came from a nearby point source where unused mixtures of fertilizer and pesticides were disposed of improperly. Nitrates in water from this well also were exceptionally high (100 mg/L as N).

Table 11.--Chemical analyses of pesticides in well and spring water
[μg/L, micrograms per liter; <, less than]

County well or spring number	Date	Geologic unit[1]	Propazine, total (μg/L)	Simazine, total (μg/L)	Metachlor in whole water (μg/L)	Toxaphene, total (μg/L)	Atrazine, total (μg/L)	Alachlor, total recover (μg/L)	Cyanazine, total (μg/L)
				Bedford County					
502	08-14-84	Obf	<0.2	0.18	<0.1	<1	0.14	<0.05	<0.2
508	08-13-84	Onl	<.2	.37	<.1	<1	<.2	<.05	<.2
629	08-14-84	Onl	<.2	.22	<.1	<1	.21	<.05	<.2
633	08-23-84	Cg	<.2	<.2	<.1	<1	<.2	.08	<.2
SP26	07-31-85	Onl	<.2	<.2	<.1	<1	<.2	<.05	<.2
SP27	08-01-85	Cg	<.2	<.2	<.1	<1	<.2	<.05	<.2
				Blair County					
394	07-21-84	Oba	<.2	<.2	<.1	<1	<.2	<.05	<.2
437	08-22-84	Oba	<.2	<.2	<.1	<1	11	20.0	<.2
459	08-22-84	Ocl	<.2	<.2	<.1	<1	.3	<.05	<.2
				Centre County					
SP17	08-08-85	Ons	<.2	<.2	<.1	<1	.3	.05	<.2
SP24	08-15-85	Obl	<.2	<.2	<.1	<1	.11	<.05	<.2
SP25	08-14-85	Ocn	<.2	<.2	<.1	<1	<.2	<.05	<.2
SP32	08-07-85	Ocn	<.2	<.2	<.1	<1	.11	<.05	<.2
				Clinton County					
SP2	08-13-85	Oa-Obf	<.2	<.2	<.1	<1	<.2	<.05	<.2
SP12	08-12-85	Cph	<.2	<.2	<.1	<1	<.2	<.05	<.2
				Mifflin County					
339	07-23-84	Obf	<.2	<.2	<.1	<1	<.2	<.05	<.2
362	07-17-84	Obl	<.2	.32	<.1	<1	.28	<.05	<.2
389	07-18-84	Obf	<.2	<.2	<.1	<1	<.2	<.05	<.2
SP2	08-22-85	Oa	<.2	<.2	<.1	<1	.1	<.05	<.2
SP3	08-22-85	Obl	<.2	<.2	<.1	<1	<.2	<.05	<.2

[1] Ocn: Coburn, Salona, and Nealmont Formations; Obl: Benner, Snyder, Hatter, and Loysburg Formations; Ocl: Coburn through Loysburg Formations; Obf: Bellefonte Formation; Oa: Axemann Formation; Oba: Bellefonte and Axemann Formations; Ons: Nittany and Larke Formations; Os: Stonehenge Formation; Cg: Gatesburg Formation; Cph: Pleasant Hill Formation.

Problems Related to Ground-Water Quality

Although the quality of ground water in all the valleys is generally suitable for most uses, the data indicate some problems are developing and problems that currently are confined to local areas could become more widespread. These are problems related to the activities of man in contrast to the scattered individual problems caused by natural processes on native minerals or distribution-system materials.

The greatest concern is the increasing nitrate concentrations in ground water. Most of the nitrate is derived from manure and artificial fertilizers applied to agricultural lands. Small amounts also come from both natural sources and septic-tank effluent. The median nitrate concentration in well water from carbonate rocks of Centre County, based on 19 analyses prior to 1971, is 2.1 mg/L (Wood, 1980, table 7). The median for 63 analyses used in this study from the same area is twice that of the earlier results, or 4.2 mg/L.

Nitrate exceeded 10 mg/L in 10 percent of the residential wells of the Nittany Valley in 1967 (Langmuir, 1971), and in 13 percent of well water analyses from the Nittany Valley used in this study. The finding of at least one herbicide in 11 of the 20 samples that were analyzed for herbicides supports an agricultural source for the nitrate problem. Both are spread widely, often simultaneously, over the cropland. The data show a trend of increasing nitrate contamination in ground water, through time, that clearly is related to agricultural practices.

A common local problem is the leakage of petroleum products into the carbonate aquifer. At least nine sites where petroleum or other organic contaminants were detected were being monitored or were undergoing clean-up during the 2 years that data were being collected for this study.

Ground-water is contaminated at several waste storage or disposal sites or is believed to be in danger of being contaminated from current or proposed future storage and disposal sites in the valleys. These include liquid waste lagoons and landfills.

Elevated concentrations of iron and manganese are sufficiently common in ground water to warrant mention. Pyritic minerals in the rocks are the likely natural source of these metals. Iron and manganese may become more prominent if acid contaminants or acid rain increase the rate these metals are leached from soil horizons.

CONCLUSIONS

Large supplies of good quality ground water are available in the 10 anticlinal valleys of central Pennsylvania that are floored by Cambrian and Ordovician carbonate rocks. The total annual withdrawals of water from all valleys is about 43 Mgal/d. Ground water supplies about 38 Mgal/d of this amount; consumptive use is estimated to be 8 Mgal/d. Current development of these water resources has tapped only a small part of the available supply in most valleys. However, pumpage of 8.1 Mgal/d in the vicinity of State College could lower water levels significantly in the area; accordingly, monitoring of water levels in that area would be prudent.

The carbonate-rock units form a heterogeneous aquifer system in each of the valleys. Heterogeneity in the yielding characteristics of the aquifer system is chiefly a function of lithologic variability. Differences in lithology directly affect the rate of solution of the carbonate rock mass. Insoluble clay, silt, and sand materials in the carbonate rocks inhibit solution, reducing the size and number of openings formed to store and transmit water. Indirectly, lithology has modified the response of the carbonate rocks to stress resulting in differences in the number, distribution, and size of fracture and bedding openings. These openings provide the network in which caves and water-bearing conduits develop. Fracture traces, visible on aerial photographs, that are oriented parallel to local cave passages can help in the selection of sites for high-production-use wells.

Large differences exist within and between the several carbonate rock units in their ability to yield water to wells. The median 1-hour specific capacities of wells, in [(gal/min)/ft], range from 0.08 (Coburn through Nealmont Formations, undivided) to 0.93 (Axemann Formation) for low-production uses and from 0.12 (Coburn through Nealmont Formations, undivided) to 33 (Nittany Formation) for high-production uses.

An ideally located well is capable of producing about 1,000 gal/min from the Gatesburg and Nittany Formations; at least 500 gal/min from the Bellefonte and Axemann Formations; at least 100 gal/min from the undivided Benner through Loysburg, undivided Coburn through Loysburg, undivided Bellefonte and Axemann, undivided Nittany and Larke, Stonehenge and Warrior Formations; and 50 gal/min or more from the undivided Coburn through Nealmont, and Rockdale Run and Shadygrove Formations. Wells located in valleys or on fracture traces have the greatest yield potential. Wells located on hilltops have the lowest yield potential.

More than 40 large springs discharge water from the carbonate rocks in these valleys. Arch Spring in the Nittany Valley and Mammoth Spring in the Kishacoquillas Valley have measured discharges more than 10,000 gal/min. About 60 percent of the large springs flow more than 1,000 gal/min.

Water-budgets for two ground-water basins, generally representative of the two types of geohydrologic systems in these valleys, show that the average ground-water discharge is 0.62 [(Mgal/d)/mi^2] from the Kishacoquillas basin and 0.80 [(Mgal/d)/mi^2] from the Spring Creek basin. The Spring Creek basin is representative of the westernmost valleys whose centers are underlain by the Gatesburg Formation, and the Kishacoquillas basin is representative of the other valleys. These discharges are available for consumptive use in each of the basins. However, water not returned to the basin may deplete streamflow. During drought periods, the ground-water discharge declines to 0.34 [(Mgal/d)/mi^2] and 0.45 [(Mgal/d)/mi^2] in the Kishacoquillas and Spring Creek basins, respectively.

The most pervasive and growing water-quality problem is the increased concentration of nitrate in ground water largely caused by agricultural practices. About 12 percent of the samples analyzed contain nitrate concentrations that exceed the USEPA's MCL of 10 mg/L. Median concentrations of nitrate range from 3.3 mg/L in the Penns, Brush, Sugar, and northern Nittany Valleys to 5.9 mg/L in the Kishacoquillas Valley. The presence of biodegradable herbicides in more than half the samples analyzed is related to the nitrate problem and the widespread application of these chemicals to cropland. Locally, water-quality problems are caused by accidental spills or leaks of petroleum products and other toxic liquid contaminants. At least nine of these local problems were discovered, were being monitored, or were undergoing cleanup in the valleys during the 2 years of field study for this project.

Iron and manganese slightly exceed the USEPA's SMCL in less than 10 percent of the analyzed samples. These metals, although aesthetically undesirable, pose no health threat for potable supplies. Solution of calcium and manganesium carbonate minerals, which comprise the bulk of the rocks in these valleys, cause the water to be alkaline and hard to very hard.

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GLOSSARY

Anticline.--A fold in layered rocks that is convex upward.

Aquifer.--A formation, group of formations, or a part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

Argillaceous.--Pertaining to rocks composed of clay or having a notable proportion of clay in their composition.

Base flow.--Discharge entering stream channels as effluent from the ground-water reservoir.

Carbonate rocks.--Rocks composed dominantly of carbonate minerals. Limestone and dolomite are the most common rocks of this type.

Calcareous.--Containing calcium carbonate.

Consumptive use.--The quantity of water withdrawn for use that is not returned to ground-water or streamflow.

Direct runoff.--The water that moves directly over the land surface to streams promptly after rainfall or snowmelt.

Discharge, groundwater.--The process by which water is removed from the saturated zone; also the quantity of water removed.

Dolomite.--A sedimentary rock composed chiefly of the mineral dolomite, $CaMg(CO_3)_2$.

Drawdown.--The lowering of the water table or potentiometric surface caused by pumping.

Evapotranspiration.--Water withdrawn from a land area by direct evaporation from water surfaces and moist soil and by plant transpiration.

Fault.--A fracture or fracture zone along which there has been displacement of the two sides relative to each other. The displacement may range from a few inches to many miles.

Formation.--A fundamental unit in rock stratigraphic classification. It is a body of rock characterized by uniform rock characteristics; it is generally tabular and is mappable at the earth's surface, or traceable in the subsurface through borings.

Fracture.--A break in rocks.

Head, static.--The height above a standard datum of the surface of a column of water that can be supported by the static pressure.

High-production use.--Includes wells used for air conditioning, dewatering, irrigation, industry, institutions, fish hatchery, and public supply purposes.

Hydraulic gradient.--Change in static head per unit of distance in a given direction.

Limestone.--A sedimentary rock composed chiefly of the mineral calcite, $CaCO_3$.

Low-production-use.--Includes wells used for homes, commerce, farms, and recreation purposes.

Median.--The middle value in an ordered sequence.

Perched ground water.--Ground water separated from an underlying body of ground water by a low-permeability or impermeable, unsaturated zone.

Permeability.--The capacity of a material to transmit a fluid.

Porosity.--The ratio of the total volume of openings in a rock to the total volume of the rock, expressed as a percentage.

Potentiometric surface.--The surface that represents the static ground water head; the potentiometric surface for an unconfined aquifer is the water table.

Recharge, ground water.--The process by which water is added to the saturated zone; also the quantity of water added.

Runoff.--That part of the precipitation that appears in streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels.

Saturated zone.--The zone in which interconnected openings are saturated with water.

Soil tonal alignments.--The linear arrangement of similar tones or shades of color observable on aerial photographs; believed to be due to a similarity in the properties of the soil.

Specific capacity.--The yield (in gallons per minute) of a well divided by the drawdown (in feet) of water level in the well.

Specific conductance.--A measure of the capacity of water to conduct an electrical current. It varies with concentration and degree of ionization of the constituents.

Sinkhole.--A circular depression at land surface in cavernous areas underlain by carbonate bedrock.

Storage coefficient.--The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. In an unconfined aquifer this value is about equal to specific yield.

Strike.--The direction of the line of intersection between a tilted surface (for example, a layer of rock) and a horizontal plane.

Swallow hole.--A sinkhole into which all or part of a stream disappears underground.

Stream-gaging station.--A gaging station where a record of discharge of a stream is obtained. Within the U.S. Geological Survey this term is used only for those gaging stations where a continuous record of discharge is obtained.

Surface water.--Water on the surface of the earth.

Transpiration.--The process by which vapor escapes from the living plant, principally the leaves, and enters the atmosphere.

Unconformity.--A surface of erosion that separates younger strata above older rocks.

Vadose water.--Water in the zone of aeration above the water table.

Water table.--The upper surface of an unconfined subsurface water body where the pressure is equal to that of one atmosphere.

Water year.--The 12-month period beginning October 1 and ending September 30. It is designated by the calendar year in which it ends.

Table 1.--Record of wells

Well location: The number is that assigned to identify the well. It is prefixed by a two-letter abbreviation of the county. The lat-long is the coordinates, in degree and minutes, of the southeast corner of a 1-minute quadrangle within which the well is located.

Use: C, commercial; D, dewater; H, domestic and small commercial; I, irrigation; N, industrial; O, observation; P, public supply; Q, agriculture; R, recreation; S, stock; T, institution; U, unused; Z, fish hatchery.

Topographic setting: D, depression; F, flat; H, hilltop; S, hillside; T, terrace; V, valley flat; W, upland draw; U, undulating.

Aquifer: Or: Reedsville Formation; Ocn: Coburn, Salona, and Nealmont Formations; Obl: Benner, Snyder, Hatter, and Loysburg Formations; Ocl: Coburn through Loysburg Formations; Obf: Bellefonte Formation; Oa: Axemann Formation; Oba: Bellefont and Axemann Formations; Orr: Rockdale Run Formation; On: Nittany Formation; Onl: Nittany and Larke Formations; Os: Stonehenge Formation; Ꞓsg: Shadygrove Formation; Ꞓg: Gatesburg Formation; Ꞓgm: Mines Member of Gatesburg Formation; Ꞓgl: lower members of Gatesburg Formation; Ꞓw: Warrior Formation; Ꞓph: Pleasant Hill Formation; Ꞓwb: Waynesboro Formation.

Lithology: dlmt, dolomite; lmsn, limestone; snds, sandstone; shle, shale; lmdm, limestone and dolomite; lmsh, limestone and shale.

Static water level: Date--month/last two digits of year.

Reported yield: gal/min, gallons per minute.

Specific capacity: [(gal/min)/ft], gallons per minute per foot of drawdown.

Rate: gal/min, gallons per minute.

Hardness: mg/L, milligrams per liter.

Specific conductance: μS/cm at 25°C, microsiemens per centimeter at 25 degrees Celsius.

Table 1.--Record of wells

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Bd 166	3954-7832	Housel	--	--	H	1,320	S	Ocl
210	4010-7825	Borough of Woodbury	--	1967	P	1,330	S	Onl/lmsn
303	4010-7824	O. Baker	Gerald W. Clark	1978	H	1,255	F	Onl/lmsn
305	4011-7825	D. Phillips	Gerald W. Clark	1979	H	1,560	H	Єg/lmsn
306	4011-7825	J. Frederick	Gerald W. Clark	1980	H	1,520	S	Єg/lmsn
309	4012-7825	S. Dively	Gerald W. Clark	1979	H	1,420	S	Єg/lmsn
310	4011-7823	E. Gates	James R. Miller	1979	H	1,220	S	Oba/dlmt
311	4010-7824	R. Manges	Gerald W. Clark	1978	H	1,290	F	Onl/lmsn
312	4010-7824	G. Batzel	Gerald W. Clark	1977	H	1,340	H	Onl/lmsn
313	4009-7823	R. Hull	Gerald W. Clark	1979	H	1,310	F	Onl/lmsn
314	4009-7823	R. Ebersole	--	1979	H	1,170	S	Oba/lmsn
315	4009-7823	H&F Welding	Gerald W. Clark	1978	N	1,190	S	Ocl/lmsn
317	4000-7827	D.R. Barker	Gerald W. Clark	1979	H	1,145	S	Єw
318	4000-7827	C. Nycum	Gerald W. Clark	1978	H	1,095	S	Єw/lmsn
320	4000-7827	T. Weber	Gerald W. Clark	1978	H	1,150	S	Єw/snds
321	4000-7827	R. Elbin	Gerald W. Clark	1978	H	1,090	S	Єw/lmsn
322	4001-7825	P. Mills	Gerald W. Clark	1978	H	1,205	S	Єg/lmsn
323	4001-7825	Ross Smith	Gerald W. Clark	1978	H	1,240	S	Єg/lmsn
324	4001-7825	R. Smith	Gerald W. Clark	1978	H	1,240	S	Єg/lmsn
325	4003-7823	Church of Brethren	Gerald W. Clark	1978	T	1,150	S	Obf/lmsn
328	3959-7828	P. Clark	Gerald W. Clark	1979	H	1,240	S	Єg
333	3954-7831	R. Cessna	Gerald W. Clark	1978	H	1,300	V	Ocl
334	3953-7830	L. Cessna	Gerald W. Clark	1979	H	1,405	S	Ocl
336	3953-7830	W. Cessna	Gerald W. Clark	1978	H	1,305	S	Ocl
385	3958-7826	Paul Deasy	Gerald W. Clark	1979	H	1,180	S	Obf/lmsn
387	3958-7828	D. Long	Gerald W. Clark	1980	H	1,390	S	Єg
389	3958-7829	Hagenbuch Feed	Gerald W. Clark	1978	H	1,480	S	Єg/lmsn
401	4003-7823	R. Miller	Gerald W. Clark	1979	H	1,145	S	Obf/lmsn
410	4013-7821	Woodbury Mennonite Church	James R. Miller	1978	H	1,345	H	Oba/lmsn
411	4013-7821	R. Steele	Gerald W. Clark	1979	H	1,400	S	Oba/lmsn
413	4013-7820	G. Noder	Gerald W. Clark	1979	H	1,420	S	Ocl/lmsn
489	4016-7822	R. Eicher	Gerald W. Clark	1979	H	1,375	S	Єg/lmsn
501	3957-7830	Roy Noonan	Gerald W. Clark	1976	H	1,510	S	Ocn/lmsh
502	3955-7829	Floyd Cornell	Jeff C. Pyle	1968	H	1,200	H	Obf/lmsn
503	3959-7828	Mike Kidd	Jeff C. Pyle	1967	H	1,270	S	Єg/lmsn
504	3958-7827	Ora Beegle	Gerald W. Clark	1975	H	1,240	F	Єg/dlmt
505	3959-7827	Nell Waugerman	Gerald W. Clark	1981	U	1,260	H	Єg/dlmt
506	3956-7829	Donald Kagarise	Jeff C. Pyle.	1966	H	1,260	V	Onl/dlmt
507	3957-7830	Ivan Lehman	Jeff C. Pyle	1982	D	1,340	S	Onl/dlmt
508	3956-7830	Ivan Lehman	Jeff C. Pyle	1982	U	1,320	V	Onl/dlmt
509	3957-7828	George Rose	Jeff C. Pyle	1967	H	1,190	V	Onl/dlmt
510	4000-7828	Donald Rose	--	1966	H	1,170	H	Єw/lmsn
511	3959-7828	Harold Kniseley	--	1966	H	1,140	H	Єg/lmsn
512	4000-7827	Eugene Shaffer	Gerald W. Clark	1977	H	1,090	V	Єw/lmsn
513	3958-7825	Fred Beegle	Gerald W. Clark	1972	H	1,250	S	Ocl/lmsn
514	3956-7829	Larry Diehl	Jeff C. Pyle	1979	H	1,170	S	Onl/lmsn
515	3954-7831	L. Baker	Jeff C. Pyle	1980	H	1,310	V	Ocl/lmsn
516	3956-7828	D. Fletcher	Jeff C. Pyle	1981	H	1,320	S	Onl/lmsn
517	3956-7829	Maron Diehl	Jeff C. Pyle	1979	H	1,370	F	Onl/lmsn

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
40	--	--	--	27	10/84	5	--	--	--	--	166 Bd
165	92	6	--	70	08/67	150	--	228	--	7.4	210
70	21	6	17/25/55	10	08/80	20	0.63/20	171	265	--	303
441	256	6	355/430/436	311	12/79	5	.06/5	--	--	--	305
366	181	6	301/357	200	01/80	30	.21/30	--	--	--	306
366	47	6	260/320/335	100	02/79	5	.01/5	--	--	--	309
101	97	6	98	36	08/80	--	--	393	600	--	310
140	110	6	98/118	80	05/78	20	.66/20	--	--	--	311
158	141	6	139/148	75	11/77	15	.24/15	--	--	--	312
326	20	6	140/280	113	08/80	3	.02/3	274	565	--	313
103	82	6	87	64	08/80	40	2.0/40	222	615	--	314
162	21	6	--	35	08/80	5	--	274	600	--	315
182	141	6	139/169	120	07/79	17	1.00/17	171	360	6.9	317
325	107	6	200/265/304	78	08/80	50	.21/50	103	265	--	318
182	164	6	163	70	08/78	16	.23/16	--	--	--	320
182	21	6	60/176	20	05/78	150	1.1/150	--	--	--	321
102	44	6	80	69	08/80	8	.13/8	274	555	--	322
264	61	6	140/194	100	09/78	6	.07/6	--	--	--	323
571	21	6	115/184	150	10/78	--	.07/150	--	--	--	324
243	21	6	98/108/209	50	10/78	10	.07/10	--	--	--	325
100	20	6	68/77	40	10/79	10	.40/10	--	--	--	328
285	34	6	32/80/182/237	30	03/80	5	.04/5	188	365	--	333
200	67	6	71	54	08/80	4	.03/4	171	365	--	334
202	61	6	191	39	08/80	4	.03/4	--	--	--	336
117	81	6	78	55	08/80	17	1.3/17	171	280	--	385
326	50	6	74/285	40	05/80	5	.02/5	--	--	--	387
332	50	6	245	180	08/80	15	--	171	265	6.8	389
79	20	6	60/71	30	04/79	12	.50/12	--	--	--	401
150	136	6	136	117	08/80	30	--	274	420	--	410
346	20	6	90/109/244	50	09/79	--	.03/5	--	--	--	411
120	21	6	52/58/100	40	03/79	12	.30/12	--	--	--	413
244	20	6	120/151	116	09/80	4	.10/4	239	455	7.3	489
223	50	6	45/55/180	20	01/76	5	.03/5	--	--	--	501
120	25	6	60	26	08/83	20	--	188	540	7.7	502
185	21	6	75	40	08/67	2	--	205	650	7.2	503
198	85	6	158/165/177/188	150	03/75	18	--	--	--	--	504
188	188	6	183	138	08/83	15	.67/15	--	--	--	505
133	40	6	100/105	--	--	20	--	188	450	7.1	506
305	42	6	250	114	08/83	--	--	324	850	6.9	507
266	--	--	--	57	08/83	--	.13/3	393	830	7.6	508
63	41	6	42/50	15	11/67	--	--	188	440	7.3	509
182	28	6	100/155/165	80	06/66	--	--	376	1,000	7.2	510
283	22	6	195/280	95	04/66	2	--	--	--	--	511
103	97	6	35/96	12	08/83	20	.29/20	239	675	7.4	512
123	70	6	110	--	--	--	--	273	600	7.2	513
105	42	6	75	--	--	20	--	--	--	--	514
85	20	6	40/58	16	09/83	8	--	256	660	7.3	515
205	63	6	125	112	09/83	3	--	188	460	8.3	516
105	63	6	75	--	--	15	--	--	--	--	517

Table 1.--Record of wells--Continued

Well location Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Bd 518	3955-7828	Ted Miller	Jeff C. Pyle	1981	H	1,250	V	Ocl/lmsn
519	3954-7829	E. Clark	Gerald W. Clark	1978	H	1,320	V	Ocl
520	3953-7831	L. Cessna	Gerald W. Clark	1982	H	1,410	V	Ocl/lmsn
521	3956-7830	W. Gates	Jeff C. Pyle	1982	U	1,400	H	Onl/dlmt
522	3956-7830	Colerain Park	Jeff C. Pyle	1983	P	1,338	S	Onl/dlmt
523	3957-7830	H. Evans	Gerald W. Clark	1981	H	1,460	S	Ocl/lmsn
524	3956-7827	W. Hartman	William J. Lochner	1983	H	1,240	S	Ocl/lmsn
525	3958-7826	P. Deasley	Gerald W. Clark	1982	U	1,170	S	Onl/dlmt
526	3958-7826	M. Boore	William J. Lochner	1982	H	1,140	S	Obf/dlmt
527	3958-7826	C. Beegle	William J. Lochner	1983	H	1,160	S	Obf/dlmt
528	3958-7826	D. Beegle	Gerald W. Clark	1982	H	1,220	S	Ocl/lmsn
529	3958-7826	Clyde Spade	Leo P. Ford	1976	H	1,200	S	Ocl/lmsn
530	3957-7828	J. Foor	William J. Lochner	1983	H	1,220	V	Obf/dlmt
531	4000-7827	Randall Putt	Gerald W. Clark	1982	H	1,100	V	Ꞓw/snds
532	4000-7827	F. Mozden	Gerald W. Clark	1982	H	1,110	S	Ꞓw/dlmt
533	4000-7827	M. Diehl	Gerald W. Clark	1981	H	1,120	S	Ꞓw/dlmt
534	4000-7827	William Harclerode	Gerald W. Clark	1981	H	1,130	S	Ꞓw/dlmt
535	4000-7827	R. Penner	Gerald W. Clark	1982	H	1,140	S	Ꞓw/dlmt
536	4000-7827	T. Weber	Gerald W. Clark	1978	H	1,150	S	Ꞓw/snds
537	4000-7827	D. Burket	Gerald W. Clark	1983	H	1,100	S	Ꞓw/dlmt
538	4000-7827	K. Valentine	Gerald W. Clark	1983	H	1.090	V	Ꞓw/dlmt
539	3959-7826	I. Morris	Jeff C. Pyle	1982	H	1,240	H	Onl/dlmt
540	3959-7827	L. Clark	Sanchez Construction Co.	1978	H	1,240	H	Ꞓg/dlmt
541	3959-7827	P. Clark	James Long	1982	H	1,240	H	Ꞓg/dlmt
542	3959-7826	G. Lenk	Gerald W. Clark	1980	H	1,230	H	Onl/dlmt
543	3958-7829	R. Evans	Gerald W. Clark	1981	H	1,490	S	Ocl/lmsn
544	3958-7829	G. Gibson	Jeff C. Pyle	1983	H	1,480	V	Ꞓg
545	4000-7828	I. Pellegrina	Gerald W. Clark	1981	H	1,060	V	Or/lmsn
546	4001-7827	D. Harclerode	Gerald W. Clark	1978	H	1,040	V	Obf/lmsn
547	4001-7827	F. Myers	William J. Lochner	1981	H	1,080	S	Oba/lmsn
548	4000-7827	C. Diehl	William J. Lochner	1981	U	1,100	V	Ꞓw/dlmt
549	4001-7826	Philip Grana	Gerald W. Clark	1977	H	1,160	S	Onl/dlmt
550	4001-7826	Lutheran Tressler	Eichelberger Well Drilling	1976	T	1,160	T	Ꞓg/dlmt
551	4001-7826	Lutheran Tressler	Eichelberger Well Drilling	1976	T	1,160	T	Ꞓg/dlmt
552	4001-7826	Snake Spring Twp.	Gerald W. Clark	1979	R	1,160	S	Ꞓg/dlmt
553	4001-7825	Bedford Hospital	Gerald W. Clark	1950	T	1,270	H	Ꞓg/dlmt
554	4001-7825	Bedford Hospital	Gerald W. Clark	1963	T	1,270	H	Ꞓg/dlmt
555	4001-7826	H. Smithberger	Gerald W. Clark	1980	H	1,130	S	Ꞓg/dlmt
556	4000-7826	Richard McConnel	Gerald W. Clark	1980	H	1,060	S	Ꞓg/dlmt
557	4001-7826	C. Timoney	Jeff C. Pyle	1981	H	1,140	H	Ꞓg/dlmt
558	4001-7826	G. Timoney	Jeff C. Pyle	1982	H	1,140	S	Ꞓg/dlmt
559	4001-7826	B. Waltman	Jeff C. Pyle	1980	H	1,150	S	Ꞓg/dlmt
560	4001-7826	R. Evans	Gerald W. Clark	1981	H	1,200	S	Ꞓg/dlmt
561	4001-7826	R. Evans	Jeff C. Pyle	1979	H	1,200	S	Ꞓg/dlmt
562	4001-7826	R. Richards	Gerald W. Clark	1983	H	1,170	S	Ꞓg/dlmt
563	4000-7824	Erie Smouse	Gerald W. Clark	--	H	1,040	H	Obf/dlmt
564	4001-7824	D. Beegle	Gerald W. Clark	1983	H	1,060	V	Onl/dlmt
565	4001-7824	J. Claycomb	Jeff C. Pyle	1981	S	1,165	V	Onl/dlmt
566	4001-7824	Donald Fluke	Gerald W. Clark	1982	H	1,040	V	Obf/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (μS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
165	42	--	70/150	36	03/81	30	--	--	--	--	518 Bd
43	33	6	33	15	12/78	20	0.80/20	--	--	--	519
325	20	6	220	29	09/83	1	--	--	--	--	520
305	72	--	--	54	09/83	--	--	--	--	--	521
405	35	6	70/170	--	--	--	--	--	--	--	522
120	32	6	36/90/100	22	08/81	50	.86/50	171	460	7.3	523
118	111	6	115	50	07/83	20	--	68	165	7.2	524
100	21	--	--	52	09/83	--	74/20	222	370	--	525
80	35	6	77	40	09/83	--	--	205	590	7.9	526
200	52	6	100/140/180	--	--	4	--	--	--	--	527
240	25	6	195	75	07/82	4	.03/4	--	--	--	528
123	23	6	--	47	09/83	--	--	205	570	7.4	529
100	28	6	35/45/65	28	09/83	9	--	188	490	7.6	530
100	96	6	77/94	46	09/83	50	2.0/50	170	420	7.8	531
117	108	6	100/110	80	02/82	20	1.00/20	--	--	--	532
150	130	6	137/148	70	08/81	30	.49/30	--	--	--	533
141	126	6	85/120/138	75	10/81	50	1.1/50	--	--	--	534
303	20	6	194/205/265	180	10/82	8	.08/8	--	--	--	535
243	224	6	223/235/243	100	12/78	35	--	--	--	--	536
97	87	6	85	50	02/83	15	--	--	--	--	537
71	21	6	57/63	11	09/83	75	--	171	575	7.4	538
240	16	6	150/230	107	09/83	4	--	205	540	7.4	539
300	21	6	187/190/280	150	06/78	10	--	119	300	7.5	540
181	181	6	--	135	09/83	--	--	--	--	--	541
254	40	6	141/242	150	10/80	20	.28/20	--	--	--	542
326	25	6	142/305	25	09/83	2	--	68	200	7.6	543
305	42	6	172	204	09/83	20	--	68	215	7.4	544
100	26	6	43	10	01/81	8	.08/8	--	--	--	545
182	20	6	40/60	40	04/78	3	.15/3	--	--	--	546
96	20	6	83	--	--	12	--	--	--	--	547
70	20	6	40/60	29	09/83	6	--	--	--	--	548
243	21	6	50/120/165/200	40	06/77	2	.01/2	--	--	--	549
475	50	6	209/217	142	10/83	35	--	--	--	--	550
425	40	6	146/342	134	10/83	60	--	--	--	--	551
203	21	6	40/59/100/197	100	04/79	23	.46/23	--	--	--	552
250	--	--	--	--	--	--	--	205	530	7.1	553
473	--	--	--	--	--	--	--	--	--	--	554
387	37	6	--	143	10/83	6	.03/6	226	620	7.6	555
100	21	6	69/80	26	10/83	30	.75/30	188	460	7.6	556
165	32	6	140	--	--	20	--	--	--	--	557
165	31	6	115/150	100	09/82	10	--	--	--	--	558
145	111	6	135	--	--	20	--	--	--	--	559
408	147	6	171/246	159	10/83	5	.04/5	256	440	7.6	560
225	61	6	167/190	--	--	4	--	--	--	--	561
151	132	4	136	120	06/83	15	1.00/15	--	--	--	562
725	--	--	200	--	--	--	--	--	--	--	563
59	40	6	42	30	10/79	5	.50/5	225	530	7.8	564
125	105	6	100/123	91	06/81	20	--	--	--	--	565
59	47	6	34/45	27	10/83	100	17/100	256	580	7.4	566

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Bd 567	4001-7824	Donald Fluke	Gerald W. Clark	1974	Z	1,040	V	Obf/dlmt
568	4004-7823	S. Goodrich	Gerald W. Clark	1980	H	1,160	V	Ocl/lmsn
569	4001-7824	Donald Dibert	Gerald W. Clark	1975	H	1,070	S	Obf/dlmt
570	4001-7824	Donald Dibert	Gerald W. Clark	1974	Z	1,060	S	Obf/dlmt
571	4004-7823	W. Lynch	Gerald W. Clark	1981	H	1,250	V	Obf/dlmt
572	4004-7822	J. Mills	Gerald W. Clark	1979	H	1,360	S	Or/shle
573	4004-7823	F. Calhoun	Gerald W. Clark	1981	H	1,300	V	Obf/dlmt
574	4003-7824	B. Barkman	Gerald W. Clark	1978	H	1,280	S	Obf/dlmt
575	4001-7825	J. Baker	Gerald W. Clark	1981	S	1,230	S	Ꞓg/dlmt
576	4001-7825	Jack Hoover	Jeff C. Pyle	1967	H	1,210	V	Onl/dlmt
577	4001-7825	D. Valigorsky	Paul N. Wright	1983	H	1,190	V	Onl/dlmt
578	4001-7825	Mahlon Diamond	Gerald W. Clark	1976	H	1,213	V	Obf/dlmt
579	4001-7827	C. Shaffer	Gerald W. Clark	1982	H	1,090	S	Ocl/lmsn
580	4001-7827	C. Shaffer	Gerald W. Clark	1982	H	1,090	S	Ocl/lmsn
581	4003-7824	Harry Wareham	Gerald W. Clark	1978	H	1,240	S	Obf/lmsn
582	4003-7824	Walter Wareham	Gerald W. Clark	1972	H	1,250	S	Obf/lmsn
583	4003-7824	Don Wareham	Jeff C. Pyle	1980	H	1,250	S	Obf/lmsn
585	3958-7828	D. Pinkston	Jeff C. Pyle	1978	H	1,280	S	Ꞓg/dlmt
586	3955-7832	C. Llewelly	Gerald W. Clark	1980	H	1,420	S	Ocl/lmsn
587	4021-7828	B. Fickes	Gerald W. Clark	1982	H	1,020	S	Or/dlmt
588	4001-7826	Bedford-Everett Vo-Tech School	Gerald W. Clark	1983	T	1,200	S	Ꞓg/dlmt
589	4001-7827	Norman Foor	Gerald W. Clark	1978	H	1,170	S	Or/shle
590	4000-7824	R. Barnes	Gerald W. Clark	1983	H	1,170	S	Or/shle
591	4003-7823	E. Weaver	Gerald W. Clark	1983	H	1,210	F	Ocl/lmsn
592	4007-7824	M. Koontz	Gerald W. Clark	1982	H	1,290	S	Ocl
593	4008-7823	Arthur Becquet	Gerald W. Clark	1983	H	1,300	S	Ocl
594	4008-7823	H. Irawfond	Gerald W. Clark	1980	H	1,200	S	Ocl/lmsn
595	4008-7825	E. Sollenberger	Gerald W. Clark	1981	H	1,270	F	Oba/dlmt
596	4003-7822	E. Weaver	Gerald W. Clark	1983	H	1,210	F	Ocl/lmsn
597	4007-7825	K. Martin	Gerald W. Clark	1982	H	1,550	W	Or/shle
598	4011-7823	J. Hale	Jeff C. Pyle	1982	H	1,300	S	Onl
599	4011-7823	John Baker	Gerald W. Clark	1980	H	1,300	W	Onl
600	4011-7824	Frank Imler	James R. Miller	1978	H	1,350	H	Onl/dlmt
601	4011-7824	Mennonite Church	Gerald W. Clark	1980	H	1,360	H	Onl/dlmt
602	4016-7824	D. Hoover	James R. Miller	1982	H	1,560	T	Ꞓg/dlmt
603	4014-7818	R. Imler	Gerald W. Clark	1983	H	1,485	S	Ꞓg/dlmt
604	4016-7824	Jack Bolgers	--	1978	H	1,500	H	Ꞓg/dlmt
605	4015-7821	Paul Ritchey	Gerald W. Clark	--	H	1,350	V	Oba/lmdm
606	4017-7823	J. Mailon	--	1979	H	1,450	S	Ꞓg/dlmt
607	4013-7821	H. Zimmerman	Gerald W. Clark	1983	H	1,320	S	Oba/lmdm
608	4012-7825	Paul Snyder	Gerald W. Clark	1973	H	1,360	V	Ꞓg/dlmt
609	4015-7822	D. Brumbaugh	Gerald W. Clark	1983	H	1,405	H	Onl/lmdm
610	4013-7826	Jacob Snyder	--	1971	H	1,420	S	Oba/dlmt
611	4013-7820	Ivan Fox	James R. Miller	1972	H	1,400	S	Oba/lmdm
612	4016-7825	Larry Closson	--	1976	H	1,220	S	Ꞓg/dlmt
613	4012-7822	Homer Harclerode	Gerald W. Clark	1977	H	1,350	H	Oba
614	4016-7824	Warren Detwiler	--	1975	H	1,530	S	Ꞓg/dlmt
615	4014-7820	John Replogle	Robert N. Eriksen	1962	H	1,448	S	Oba

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
43	20	6	34	12	04/74	75	--	--	--	--	567 Bd
75	45	6	28/41/60	45	10/83	25	1.3/25	111	480	7.7	568
103	103	4	83	51	10/83	10	0.20/10	--	--	--	569
163	24	6	96	96	11/74	8	--	--	--	--	570
228	212	4	100	80	11/81	7	.30/7	--	--	--	571
83	20	6	58/63	21	10/83	20	.50/20	103	250	7.7	572
290	69	6	95/180/285	80	01/81	15	.07/15	--	--	--	573
383	40	6	242/284/320	62	10/83	15	.06/15	205	570	7.4	574
182	148	6	162	141	07/81	10	1.1/10	--	--	--	575
283	45	6	100/180	80	03/67	3	.02/3	273	700	7.2	576
346	53	6	50/142/262/285	71	10/83	3	.01/3	--	--	--	577
243	17	6	54/210	28	10/83	2	--	273	600	7.1	578
113	--	5	90	30	11/82	30	.44/30	--	--	--	579
173	22	6	83/150	36	10/83	12	.12/12	--	--	--	580
383	21	6	100/168/320	70	11/78	4	.01/4	--	--	--	581
90	21	6	73	20	05/72	12	.16/12	--	--	--	582
105	71	6	90	32	10/83	20	--	--	--	--	583
245	21	6	120/135	99	05/84	--	--	256	625	--	585
180	27	6	80/160	41	04/83	5	.03/5	222	480	7.1	586
141	43	6	78/130	22	04/84	7	--	85	230	7.8	587
244	95	6	151/201/213/223	154	10/84	50	--	--	--	--	588
79	21	6	17/30/59	8	01/78	50	--	--	--	--	589
--	25	6	19/59/70	25	04/84	35	--	68	200	7.0	590
--	21	6	80/257/290/365	53	04/84	9	--	188	490	7.1	591
59	49	4	38/43	5	04/84	20	--	102	360	6.8	592
325	2	6	55/75	49	04/84	2	--	119	350	6.6	593
121	82	6	34/78/90/100	23	04/84	100	--	102	300	7.1	594
480	21	6	134/315/465	28	04/84	--	--	171	420	7.3	595
180	--	--	--	2	04/84	--	--	--	--	--	596
162	22	6	40/50/138	12	04/84	6	.09/6	68	220	7.7	597
105	31	--	72	--	--	10	--	--	--	--	598
305	31	6	121/158/280	150	11/80	50	--	--	--	--	599
177	--	--	--	109	04/84	--	--	188	430	7.1	600
160	66	6	127/137/142	115	08/80	18	.72/18	--	--	--	601
--	--	--	--	--	--	--	--	68	110	7.9	602
121	73	6	100/106/112	53	05/84	25	.80/25	171	305	--	603
390	--	--	--	--	--	--	--	119	260	7.8	604
--	--	--	--	10	05/84	--	--	290	615	--	605
221	--	--	--	--	--	--	--	68	200	7.7	606
408	21	6	8/25/230	9	06/84	--	.03/4	--	--	--	607
--	--	--	--	17	05/84	--	--	290	415	7.5	608
241	225	4	217/230	124	06/84	--	--	188	410	--	609
155	106	6	140	34	05/84	15	--	153	460	7.9	610
66	20	6	20/50/60	10	06/84	18	--	290	660	--	611
--	150	6	--	65	05/84	--	--	17	60	6.4	612
418	21	6	120/278/318/398	200	07/77	6	.04/6	--	--	--	613
--	--	--	--	--	--	--	--	188	420	7.2	614
126	--	--	--	43	06/84	--	--	239	490	--	615

Table 1.--Record of wells--Continued

Well location Number	Well location Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Bd 616	4014-7825	Ronald Stauffer	James R. Miller	1978	H	1,426	F	Єg/dlmt
617	4015-7820	Ernest Chronister	Fred D. Albright	1974	H	1,455	S	Oba
618	4013-7825	--	--	1974	H	1,440	H	Onl/lmdm
619	4014-7821	William Logue	Robert N. Eriksen	1962	H	1,270	V	Oba
620	4011-7824	Herbert Leonard	Gerald W. Clark	1984	H	1,440	H	Onl/dlmt
621	4012-7822	Vance Fletcher	--	1982	H	1,320	H	Oba
622	4007-7824	John Gates	--	1954	H	1,280	V	Ocl
623	3956-7831	Arlo Greer	--	--	H	1,440	V	Onl/dlmt
624	4017-7824	Jack Butler	James R. Miller	1976	H	1,470	S	Єg
625	3955-7831	Wayne Keller	--	--	H	1,390	S	Obf/dlmt
627	3956-7830	Colerain Twp. School	--	--	T	1,400	S	Onl/lmdm
629	4002-7824	Glen Hoover	--	--	H	1,120	V	Onl/lmdm
633	4010-7825	Joe Furry	Reuben L. Hollopeter	--	H	1,350	S	Єg/dlmt
640	3953-7832	Vance Fredrick	--	--	U	1,340	V	Ocl/lmsn
642	3954-7831	Yeager Church	Gerald E. Carpenter	1977	H	1,329	V	Ocl/dlmt
644	4004-7823	Bollman	Gerald W. Clark	1984	H	1,260	V	Obf
646	4003-7823	David Freeze	Gerald W. Clark	1984	H	1,210	V	Obf
647	3956-7830	P.O.S.H.	Jeff C. Pyle	1967	H	1,370	S	Onl/lmsn
Ba 1	4019-7819	Irvin Stoner	--	--	H	1,420	S	Oba/dlmt
150	4032-7810	Joseph McCullough	James R. Miller	1976	H	950	H	Єg
220	4017-7823	P. Snowberger	Gerald W. Clark	1978	H	1,380	V	Onl/lmsn
221	4018-7824	R. Wakefield	Gerald W. Clark	1979	H	1,330	S	Onl/lmsn
222	4018-7825	W. Mock	Gerald W. Clark	1979	H	1,310	S	Ocl
223	4019-7822	B. Mock	James R. Miller	1978	H	1,400	H	Oba/lmsn
248	4018-7817	C. Walter	James R. Miller	1979	H	1,335	S	Onl/lmsn
250	4019-7817	Gary Speck	Gerald W. Clark	1975	H	1,445	S	Onl/lmsn
251	4017-7819	Daniel Legg	Gerald W. Clark	1977	H	1,495	S	Onl/lmsn
252	4017-7819	Larry Jones	Gerald W. Clark	1976	H	1,475	S	Onl/lmsn
253	4015-7819	Harry Miller	Gerald W. Clark	1977	H	1,470	F	Oba/lmsn
254	4015-7818	E. Bridenbaugh	James R. Miller	1977	H	1,470	S	Єgm/lmsn
270	4019-7823	J. Destefan	Fred D. Albright	1978	H	1,420	S	Oba/lmsn
272	4018-7823	Donald Imes	Gerald W. Clark	1977	H	1,320	V	Onl/lmsn
297	4029-7811	F. England	James R. Miller	1979	H	938	S	Onl/lmsn
298	4029-7810	Louis Heller	James R. Miller	1976	H	985	S	Oba/lmsn
329	4018-7818	Martinsburg Borough	Moody Drilling Co., Inc.	1967	U	1,435	F	Єg
330	4018-7818	Martinsburg Borough	Moody Drilling Co., Inc.	1967	P	1,440	F	Єg
338	4016-7820	Curryville Water Auth.	--	1975	P	1,450	S	On
339	4016-7820	Curryville Water Auth.	--	1968	P	1,425	H	Onl
344	4027-7812	Williamsburg Municipal Authority	--	1969	P	1,055	W	Єg
345	4027-7812	Williamsburg Municipal Authority	--	1969	P	1,070	W	Єg
356	4017-7822	D. Kensinger	Gerald W. Clark	1981	H	1,433	F	Onl/dlmt
357	4017-7822	D. Kensinger	--	--	U	1,433	F	Onl/dlmt
358	4017-7822	John Mellott	James R. Miller	1975	H	1,460	H	Onl/dlmt
360	4026-7811	Williamsburg Bible Baptist Church	James R. Miller	1979	I	1,085	S	Oba
361	4026-7810	R. Keene	James R. Miller	1979	H	1,090	S	Ocl
362	4024-7813	Eli Smith	James R. Miller	1978	H	1,142	S	Єg

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
285	--	--	--	46	05/84	--	--	17	300	8.6	616 Bd
148	46	6	140	46	06/84	7	--	--	--	--	617
400	--	--	--	--	--	--	--	188	600	7.7	618
50	--	--	--	9	06/84	--	--	256	520	--	619
162	21	6	74/121/135	91	05/84	7	0.30/7	290	760	7.4	620
250	--	6	--	59	06/84	6	.20/4.2	427	1,050	--	621
130	--	--	--	40	05/84	--	--	307	725	7.5	622
325	--	--	--	166	07/84	--	--	273	565	--	623
510	201	6	300	--	--	--	--	205	540	7.3	624
50	--	--	--	23	07/84	--	--	342	650	--	625
--	--	--	--	100	07/84	--	--	--	--	--	627
--	--	--	--	16	07/84	50	--	256	520	7.7	629
110	--	--	--	72	07/84	50	--	102	240	--	633
--	--	--	--	13	08/84	--	--	--	465	7.9	640
248	42	6	90	35	10/84	75	--	--	--	--	642
--	--	--	--	59	10/84	--	--	--	--	--	644
480	--	--	--	71	10/84	--	--	--	--	--	646
63	21	6	40	32	02/67	15	--	--	--	--	647
180	12	5	--	50	08/33	9	.90/9	--	--	--	1 Ba
223	--	--	--	--	--	1	--	256	509	--	150
162	93	6	141/158	100	11/78	15	.50/15	--	--	--	220
326	54	6	200/280/315	80	08/79	15	.07/15	--	--	--	221
264	20	6	58/223/264	100	10/79	6	.06/6	--	--	--	222
182	102	5	137/150	121	06/80	9	--	340	605	--	223
145	60	6	135	58	06/80	8	--	188	450	--	248
261	66	6	143/235/250/258	100	07/75	15	.07/15	120	250	--	250
152	--	6	133	120	03/77	8	.62/8	--	--	--	251
261	107	6	122/230	100	03/76	6	.05/6	--	--	--	252
123	19	6	113	83	03/77	6	.30/6	--	--	--	253
285	175	6	240/275	169	06/80	60	--	137	305	--	254
360	46	6	350/355	118	07/80	12	--	291	605	--	270
143	116	6	120/126/130	89	07/80	12	40/12	154	435	--	272
247	57	6	222/230	--	--	2	--	205	427	7.0	297
500	21	6	105/215/433	--	--	8	--	308	605	7.3	298
296	223	6	140	97	05/67	--	10.0/230	--	--	--	329
350	145	6	162	94	03/67	--	13/230	--	--	--	330
396	--	--	--	49	03/75	--	.04/12	--	--	--	338
223	45	6	--	--	--	150	--	--	--	--	339
487	116	8	--	210	01/69	300	7.1/300	--	--	--	344
417	264	8	--	219	01/69	300	30/300	--	--	--	345
525	123	6	223/302/420	136	10/83	15	.05/15	153	400	1.0	356
225	--	--	--	124	10/83	--	--	--	--	--	357
240	58	6	218/230	--	--	--	--	--	--	--	358
217	211	4	95/200	--	--	10	--	391	813	--	360
400	111	6	350/390	--	--	3	--	154	335	7.2	361
125	115	4	98	--	--	18	--	240	467	--	362

Table 1.--Record of wells--Continued

Well location						Altitude of land		
Number	Lat-Long	Owner	Driller	Year completed	Use	surface (feet)	Topo- graphic setting	Aquifer/ lithology
Ba 365	4017-7822	J. Johnson	James R. Miller	1978	H	1,460	H	Onl/dlmt
366	4016-7822	James Snyder	Gerald W. Clark	1979	H	1,410	H	Onl/dlmt
367	4016-7822	D. Pressel	David R. Eriksen	1980	H	1,420	S	Onl/dlmt
368	4017-7822	M. Stayduhar	Gerald W. Clark	1981	H	1,424	F	Onl/dlmt
369	4017-7822	Guyer	--	--	O	1,460	H	Onl/dlmt
379	4019-7822	G. Lanzendofer	James R. Miller	1979	H	1,340	V	Obl/dlmt
380	4019-7822	O. Clair	Harold E. Ritchey	1978	H	1,360	S	Obf/dlmt
383	4026-7813	Jack Mock	James R. Miller	1967	H	1,220	W	Ꞓg/dlmt
384	4026-7813	Jack Mock	Oscar Dearmit	1983	H	1,230	W	Ꞓg/dlmt
385	4027-7812	Ralph Grove	W.R. Parks, Jr.	1970	H	1,140	W	Ꞓg/dlmt
386	4026-7812	Alfred Biddle	James R. Miller	1978	H	1,150	S	Onl/dlmt
387	4026-7812	Robert Stone	M.R. Sensebaugh	1966	H	1,140	W	Onl/dlmt
388	4026-7811	Rose King	James R. Miller	1975	H	1,190	H	Onl/dlmt
389	4024-7812	St. Johns Lutheran Church	James R. Miller	1976	H	1,110	V	Onl/dlmt
390	4025-7812	Guy Fern	Martin W. Shatzer	1983	H	1,150	S	Obf/dlmt
391	4025-7812	Joe Burkhard	James R. Miller	1978	H	1,150	S	Oba/dlmt
392	4028-7812	Penelec Company	PA Drilling Company	1981	N	840	V	Ꞓg/dlmt
393	4028-7810	James Dale	James R. Miller	1977	H	840	S	Oba/dlmt
394	4026-7811	Baptist Church	James R. Miller	1981	U	1,080	H	Oba/dlmt
395	4026-7811	James Miller	James R. Miller	1979	H	1,010	S	Oba/dlmt
396	4025-7810	M. Speck	James R. Miller	1980	U	1,220	S	Ocl/lmsn
397	4028-7813	O. Cairns	James R. Miller	1968	H	870	V	Oba/dlmt
398	4028-7814	Matthew Derbonitz	James R. Miller	1968	H	910	S	Ocn/lmsn
399	4027-7812	R. Clouse	James R. Miller	1981	H	1,040	H	Ꞓg/lmsn
400	4027-7814	Francis Stone	James R. Miller	1969	H	1,050	W	Oba/dlmt
401	4026-7813	Roth	James R. Miller	1978	H	1,120	S	Ꞓg/dlmt
402	4026-7813	John Strayer	James R. Miller	1978	H	1,160	S	Ꞓg/dlmt
403	4026-7814	R. Frye	James R. Miller	1982	H	1,150	V	Oba/dlmt
404	4025-7816	Laurel Pipe Company	James R. Miller	1983	U	1,130	S	Ocl/lmsn
405	4025-7816	Laurel Pipe Company	James R. Miller	1983	U	1,150	S	Ocl/lmsn
406	4025-7816	Laurel Pipe Company	James R. Miller	1983	U	1,180	S	Ocl/lmsn
407	4024-7815	D. Weber	James R. Miller	1979	H	1,250	F	Ꞓg/lmdm
408	4024-7815	Robert Hess	James R. Miller	1977	H	1,250	--	Ꞓg/lmdm
409	4024-7815	J. Rupeka	James R. Miller	1980	H	1,280	S	Onl/dlmt
410	4018-7820	L. Miller	James R. Miller	1982	H	1,360	V	Ocl/lmsn
411	4018-7822	R. Burkel	James R. Miller	1980	H	1,480	S	Oba/dlmt
412	4028-7811	Penelec Company	PA Drilling Company	1983	U	987	S	Onl
413	4028-7811	Penelec Company	PA Drilling Company	1983	U	987	S	Onl
414	4028-7811	Penelec Company	PA Drilling Company	1983	U	990	S	Onl/dlmt
415	4028-7811	Penelec Company	PA Drilling Company	1983	U	987	S	Onl/dlmt
416	4026-7811	Penelec Company	PA Drilling Company	1983	U	909	S	Onl/dlmt
417	4028-7811	Penelec Company	PA Drilling Company	1983	U	988	S	Onl/dlmt
418	4018-7824	J. Kaurudar	James R. Miller	1978	H	1,380	F	Onl/dlmt
419	4018-7824	R. Dick	James R. Miller	1980	H	1,370	S	Onl/dlmt
420	4017-7824	Walter Myers	James R. Miller	1978	H	1,490	S	Ꞓg
421	4017-7824	P. Myers	James R. Miller	1980	H	1,460	S	Ꞓg
422	4017-7824	Curry	James R. Miller	1980	H	1,440	S	Ꞓg
423	4019-7823	Hanover Cannery Company	James R. Miller	1982	H	1,260	S	Onl
424	4019-7823	R. Bridenbaugh	James R. Miller	1981	H	1,420	H	Oba/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
205	200	4	180/188	--	--	21	--	--	--	--	365 Ba
187	177	4	135/165	--	--	15	0.88/15	--	--	--	366
225	15	6	125/205/210	129	10/83	7	--	--	--	--	367
285	138	5	195/223/257	110	12/81	20	.14/20	--	--	--	368
329	--	--	--	146	10/83	--	--	--	--	--	369
145	132	4	110/130	110	12/81	36	--	--	--	--	379
270	21	6	252	112	10/83	3	--	308	975	6.9	380
272	62	6	225/262	250	10/67	10	--	--	--	--	383
329	--	--	--	248	04/84	--	--	--	--	--	384
143	--	--	--	124	01/70	6	--	--	--	--	385
225	220	4	192	--	--	9	--	188	370	7.4	386
170	62	6	157	147	12/66	15	--	--	--	--	387
325	21	6	210	150	07/75	5	--	307	810	6.8	388
105	46	6	70/100	54	04/84	18	--	205	480	7.2	389
180	--	--	--	105	04/84	18	2.6/6	273	600	6.6	390
185	180	4	140/160	--	--	12	--	--	--	--	391
357	57	8	92/117/157	6	04/84	100	2.0/100	--	--	--	392
165	85	6	103	--	--	36	--	--	--	--	393
386	21	6	151/355/375	28	04/84	--	.004/2.0	307	620	7.2	394
260	21	6	245	--	--	--	--	307	750	6.9	395
411	36	6	309	15	04/84	1	--	--	--	--	396
152	20	6	20/64/134	20	10/68	3	.03/3	256	1,200	6.9	397
68	20	6	42	18	09/68	2	.08/2	376	775	6.8	398
349	21	6	100/320	150	04/84	1	--	171	490	7.0	399
128	70	6	122	92	08/69	15	.50/15	307	700	6.7	400
355	208	6	295/335	215	04/84	--	--	135	290	7.3	401
--	300	4	217/320	--	--	6	--	51	140	7.1	402
206	206	4	196	103	04/84	12	--	239	650	7.1	403
107	57	12	58	--	--	75	--	--	--	--	404
112	44	6	70/101	49	10/83	30	--	--	--	--	405
87	64	6	67	86	10/83	1	--	--	--	--	406
217	164	6	190	117	04/84	4	--	119	250	7.5	407
450	45	6	--	--	--	1	--	--	--	--	408
305	148	6	200/246	114	11/80	3	--	205	490	7.2	409
83	20	6	64	--	--	40	--	290	710	7.0	410
267	37	6	236/256	--	--	4	--	--	--	--	411
160	156	4	--	123	03/84	--	--	--	430	7.2	412
158	153	4	--	119	03/84	3	--	--	330	7.4	413
164	164	4	--	125	03/84	--	--	--	310	7.5	414
--	156	4	--	124	03/84	1	--	--	390	7.5	415
90	83	4	--	48	03/84	4	3.1/4	--	307	7.4	416
160	155	4	--	120	04/84	--	--	--	580	7.3	417
185	175	4	--	--	--	10	--	--	--	--	418
400	400	4	145	30	10/80	1	--	342	900	6.8	419
305	131	5	--	246	04/84	5	--	119	320	7.3	420
322	169	6	--	234	04/84	16	--	153	350	7.6	421
225	195	6	198	--	--	18	--	--	--	--	422
206	20	6	123	79	04/84	2	.08/5.3	307	975	7.1	423
400	21	6	252/390	120	04/84	12	--	239	510	7.2	424

Table 1.--Record of wells--Continued

Well location						Altitude of land		
Number	Lat-Long	Owner	Driller	Year completed	Use	surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ba 425	4019-7823	Dennis Gates	James R. Miller	1984	H	1,420	F	Oba/dlmt
426	4018-7824	P. Tremmil	Fred D. Albright	1978	H	1,310	F	Onl/dlmt
427	4016-7821	J. Drake	James R. Miller	1980	H	1,460	H	Oba/dlmt
428	4017-7823	Zally Price	Gerald W. Clark	1981	H	1,420	W	Onl/dlmt
429	4017-7821	Ronald Metzler	James R. Miller	1981	S	1,440	S	Oba/dlmt
430	4018-7823	S. Ayers	Gerald W. Clark	1979	H	1,360	F	Onl/dlmt
431	4017-7821	Ronald Metzler	James R. Miller	1978	S	1,440	S	Oba/dlmt
432	4018-7823	J. Powley	James R. Miller	1981	H	1,370	F	Onl/dlmt
433	4018-7820	Kenneth Ritchey	James R. Miller	1978	H	1,345	V	Ocl/lmsn
434	4018-7823	B. Dauberman	Jeff C. Pyle	1982	H	1,340	S	Onl/dlmt
435	4018-7820	Ritchey's Dairy	James R. Miller	1978	N	1,345	V	Ocl/lmsn
436	4018-7824	Charles Richardson	James R. Miller	1977	H	1,360	W	Ꞓg/dlmt
437	4017-7819	N. Woodbury Twp.	James R. Miller	1980	Z	1,435	S	Oba/dlmt
438	4018-7824	Thomas Kennedy	James R. Miller	1976	H	1,360	S	Ꞓg/dlmt
439	4017-7819	D. McKee	Gerald W. Clark	1978	H	1,500	S	Onl/lmdm
440	4017-7824	Fred Shoenfelt	Donald W. Graham	1979	H	1,420	S	Ꞓg/dlmt
441	4017-7819	Bruce Whalen	James R. Miller	1980	H	1,475	S	Onl/lmdm
442	4019-7824	R. Smith	James R. Miller	1982	H	1,270	S	Oba/dlmt
443	4017-7818	George Bridenbaugh	Gerald W. Clark	1974	H	1,455	H	Onl/dlmt
444	4018-7824	Bill Wilbern	Jeff C. Pyle	1982	H	1,340	S	Ꞓg
445	4015-7819	Harry Miller	James R. Miller	1977	H	1,450	S	Oba/dlmt
446	4018-7824	D. Keith	Jeff C. Pyle	1982	H	1,350	S	Onl/dlmt
447	4017-7816	D. Baker	James R. Miller	1981	H	1,300	W	Oba/dlmt
448	4029-7812	R. Hoffner	James R. Miller	1981	H	1,110	S	Ꞓg/lmsn
449	4019-7818	Steve Kensinger	James R. Miller	1978	H	1,440	S	Ꞓg/snds
450	4029-7812	G. Kagarise	James R. Miller	1979	H	980	W	Ꞓg/lmsn
451	4019-7817	William Robinson	James R. Miller	1980	H	1,440	S	Onl/lmdm
452	4023-7816	Galen Miller	James R. Miller	1970	H	1,210	S	Onl/dlmt
453	4017-7818	Morrison Cove Livestock	--	--	C	1,480	H	Onl/lmdm
454	4023-7816	Dale Longenecker	James R. Miller	1970	H	1,210	S	Onl/dlmt
455	4016-7817	Kenneth Snyder	James R. Miller	1980	H	1,405	S	Ocl/lmsn
456	4024-7816	Denver Gorsuch	James R. Miller	1972	H	1,190	S	Onl/dlmt
457	4019-7821	Anthony Wineland	James R. Miller	1975	H	1,360	S	Ocl/lmsn
458	4024-7815	Eugene Biddle	James R. Miller	1968	H	1,350	S	Ꞓg/dlmt
459	4018-7820	Youngs, Inc.	James R. Miller	1977	N	1,345	H	Ocl/lmsn
460	4024-7817	Carmel Camaroto	James R. Miller	1984	H	1,280	S	Ocl/lmsn
461	4022-7817	Glenn Smith	James R. Miller	1970	H	1,280	S	Onl/lmdm
462	4024-7816	Carmel Camaroto	W.R. Parks, Jr.	1974	H	1,240	S	Oba/dlmt
463	4020-7817	S. Johnson	Oscar Dearmit	1978	H	1,445	W	Ꞓg/dlmt
464	4023-7817	L. Burket	Oscar Dearmit	1968	U	1,190	V	Oba/dlmt
465	4020-7817	James Walter	Robert N. Eriksen	1978	H	1,490	S	Ꞓg/dlmt
466	4023-7817	Leonard Burket	--	1958	H	1,190	V	Oba/dlmt
467	4020-7817	A. Hileman	James R. Miller	1980	H	1,460	W	Ꞓg/dlmt
468	4023-7817	Robert Stultz	James R. Miller	1976	H	1,240	F	Onl
469	4020-7819	Gene Davis	--	1979	H	1,480	S	Or/shle
470	4025-7815	Joyce Verhonitz	James R. Miller	1976	H	1,010	S	Oba/dlmt
471	4019-7819	John Davis	--	--	U	1,405	V	Oba/dlmt
472	4022-7815	Robert Smith	Gerald W. Clark	1982	H	1,230	W	Ꞓw/lmsn
473	4018-7821	Russell Steel	Fred D. Albright	1979	H	1,370	H	Oba/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depths to water-bearing zones (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
--	--	--	--	100	04/84	--	--	--	--	--	425 Ba
135	135	4	125	50	04/78	15	0.21/15	--	--	--	426
268	163	6	240/255	81	05/84	10	.12/6	239	470	--	427
223	--	--	162/195/205	72	05/84	9	--	359	900	6.9	428
371	42	6	275/365	--	--	8	--	--	--	--	429
203	20	6	94/135/175/192	55	05/84	20	20.0/5.8	290	650	7.5	430
325	21	6	115/225	38	05/84	1	--	376	700	--	431
162	91	6	97/105/138/148/159	63	05/84	20	--	119	420	7.3	432
160	42	6	28/80/110	2	05/84	2	--	--	--	--	433
245	21	6	205	150	12/82	4	--	--	--	--	434
50	21	6	35/45	--	--	50	--	--	--	--	435
130	114	6	114/128	77	05/84	18	--	239	750	7.6	436
105	21	6	0.29	15	05/84	6	.29/6.6	--	1,000	6.4	437
165	160	4	140/155	108	10/84	30	--	--	--	--	438
183	84	6	110/160	89	05/84	--	--	--	--	--	439
185	75	6	--	--	--	--	--	136	280	7.9	440
165	109	6	115/143	63	05/84	10	--	310	625	--	441
227	20	6	35	20	05/84	1	--	239	700	7.0	442
115	132	4	90/100	46	05/84	10	.50/10	393	855	--	443
145	--	--	123	80	05/84	30	--	205	490	7.0	444
300	38	6	162/207	65	05/84	5	--	239	550	--	445
145	--	--	--	93	05/84	--	--	--	--	--	446
105	42	6	83	24	05/84	50	--	222	470	--	447
305	300	4	55/275	27	06/84	--	--	273	600	6.9	448
215	210	6	190	182	05/84	30	--	102	185	--	449
90	85	6	--	19	06/83	125	--	239	590	6.9	450
280	264	4	145/278	88	05/84	5	--	120	245	--	451
120	20	6	75/110	64	05/84	6	--	188	520	7.0	452
180	--	--	--	84	05/84	--	--	222	465	--	453
130	20	6	80/120	--	--	--	--	188	490	7.2	454
165	31	6	130	26	05/84	3	--	137	280	--	455
160	27	6	67/90	--	--	200	--	--	--	--	456
325	37	6	43/265	35	06/84	2	--	188	460	--	457
371	135	6	110/355	--	--	1	--	205	420	7.2	458
145	45	6	120/135	27	05/84	36	.28/16	290	535	7.4	459
245	21	6	105/175	25	05/84	2	--	102	380	7.2	460
160	26	6	90/120	70	10/70	--	--	--	--	--	461
90	40	6	65/88	--	--	10	--	188	580	7.1	462
350	320	6	345	--	--	8	--	--	--	--	463
308	36	6	190	--	--	2	--	--	--	--	464
310	310	6	310	179	05/84	--	--	85	160	8.0	465
--	--	--	--	--	--	--	--	290	850	7.2	466
193	190	6	190	--	--	36	--	--	--	--	467
--	--	--	--	81	05/84	--	--	222	610	7.3	468
69	--	--	--	10	05/84	--	--	102	240	--	469
1,010	--	--	--	--	--	--	--	256	810	7.1	470
60	--	--	--	15	05/84	--	--	--	--	--	471
215	206	4	--	60	05/84	5	--	153	370	7.2	472
180	20	6	150/160/175	7	05/84	12	--	--	--	--	473

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Ba 474	4022-7815	R. Smith	James R. Miller	1984	H	1,250	S	Ꞓw/lmsn
475	4019-7818	J. Replogle	James R. Miller	1980	S	1,505	S	Onl/lmdm
476	4024-7813	Sam Robley	James R. Miller	1979	H	1,260	S	Ꞓg/dlmt
477	4022-7816	James Baker	--	1963	U	1,280	S	Onl/lmdm
478	4025-7812	Larry Mock	James R. Miller	1976	H	1,050	V	Onl/dlmt
479	4022-7816	Gary Baker	Oscar Dearmit	--	H	1,260	S	Onl/lmdm
480	4025-7812	Davis	--	1981	H	1,020	V	Onl/dlmt
481	4022-7816	James Baker	James R. Miller	1980	H	1,300	S	Onl/lmdm
482	4025-7812	Larry Mock	James R. Miller	1969	H	1,060	S	Onl
483	4017-7822	Jerry Ritchey	--	--	H	1,480	S	Oba/dlmt
484	4024-7812	John Loose	James R. Miller	1969	H	1,090	S	Onl/dlmt
485	4016-7818	Dennis Ayers	James R. Miller	1977	H	1,410	V	Ocl/lmsn
486	4024-7812	Wayne Loose	James R. Miller	1972	H	1,210	S	Ocl/dlmt
487	4018-7819	Dale Hoover	James R. Miller	1970	H	1,420	H	Or/shle
488	4024-7811	Larry McCall	--	1982	H	1,270	S	Ocl
489	4021-7815	Lloyd Acker	M.R. Sensebaugh	1970	H	1,260	H	Onl/lmdm
490	4024-7811	Daniel Detwiler	--	1973	H	1,200	S	Ocl
491	4020-7816	Paul Nolt	--	--	H	1,260	S	Onl/lmdm
492	4024-7814	M. Oswald	James R. Miller	1978	H	1,140	V	Ꞓg
493	4018-7816	Kenneth Baker	Sanchez Construction Co.	1966	H	1,295	S	Ocl/lmsn
494	4021-7823	R. Talbert	M.R. Sensebaugh	1965	H	1,320	S	Oba/dlmt
495	4018-7817	James Byler	James R. Miller	1978	H	1,370	H	Oba/lmdm
496	4020-7823	Flanagan's Auto Body	--	--	H	1,340	S	Oba/dlmt
497	4020-7815	A. Gearhart	James R. Miller	1978	H	1,260	S	Oba/lmdm
498	4020-7822	Glen Glass	James R. Miller	1976	H	1,280	S	Ocl
499	4019-7817	Michael Albright	Robert N. Eriksen	1983	H	1,420	S	Onl/lmdm
500	4018-7823	K. Keith	Gerald W. Clark	1980	H	1,250	S	Onl
501	4017-7819	D. Legge	Gerald W. Clark	1981	H	1,510	S	Onl/lmdm
502	4028-7811	E. Burgea	James R. Miller	1976	H	1,110	H	Onl/lmsn
503	4017-7819	H. Barley	James R. Miller	1980	H	1,500	S	Onl/lmdm
504	4028-7811	John Hoover	James R. Miller	1976	U	1,010	H	Onl/dlmt
505	4017-7819	Pauline Dowricks	Gerald W. Clark	1979	H	1,500	S	Onl/lmdm
506	4025-7816	Marcellus Umbrower	--	--	H	1,120	S	Oba
507	4017-7819	R. Greenleaf	James R. Miller	1982	H	1,500	S	Onl/lmdm
508	4025-7816	James Robley	James R. Miller	1968	H	1,120	S	Oba/dlmt
510	4020-7823	James Robley	James R. Miller	1980	H	1,360	H	Oba/dlmt
512	4020-7823	R. Albright	--	--	H	1,380	H	Oba
514	4022-7817	Smithfield Church	Oscar Dearmit	1967	H	1,272	V	Onl/dlmt
516	4022-7814	Salems Church of Christ	James R. Miller	1968	H	1,191	H	Onl/dlmt
518	4030-7810	James Roller	James R. Miller	1978	H	1,030	V	Onl/dlmt
520	4030-7810	Albert Werts	James R. Miller	1973	H	790	S	Oba
522	4030-7811	Dave Stubbs	--	1949	H	900	V	Ons
524	4030-7812	Richard Lynn	--	1978	H	1,020	W	Onl/dlmt
526	4030-7812	E. Bottonfield	James R. Miller	1970	H	1,140	S	Ꞓg
528	4031-7810	J. Hick	James R. Miller	1982	H	790	V	Oba/dlmt
530	4031-7811	P. Esteps	--	1974	H	1,050	S	Onl/dlmt
532	4030-7813	Mike Rosser	James R. Miller	1981	H	1,250	S	Oba/dlmt
534	4030-7813	Mike Rosser	--	--	U	1,250	S	Oba/dlmt
536	4028-7814	Richard Michelone	--	1968	H	940	S	Oba/lmdm

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
182	38	6	100/150/160	90	05/84	12	--	136	350	7.2	474 Ba
195	186	4	153/185	138	05/84	7	--	205	500	--	475
--	--	--	--	186	05/84	--	--	119	280	7.2	476
400	--	--	--	16	05/84	--	--	--	--	--	477
125	20	6	70/120	41	05/84	4	--	--	--	--	478
--	--	--	30	18	05/84	--	0.17/10	222	410	7.6	479
65	--	--	--	--	--	26	--	--	--	--	480
--	--	6	--	76	05/84	--	--	137	300	--	481
87	82	6	74/85	40	10/84	30	--	239	675	7.1	482
203	--	6	--	99	05/84	15	.30/15	256	560	--	483
122	18	6	95/118	37	05/84	100	--	188	420	7.4	484
90	87	6	89	44	06/84	20	2.30/8.0	239	540	7.8	485
190	35	6	138/178	40	01/72	5	--	119	300	7.6	486
107	19	6	--	11	06/84	6	.07/6	--	--	--	487
350	--	--	--	58	05/84	--	--	205	525	7.2	488
123	118	6	118	83	06/84	15	--	239	495	--	489
270	--	--	--	--	--	1	--	256	740	7.1	490
70	--	--	--	31	06/84	--	--	--	550	7.9	491
145	145	4	115/132	--	--	30	--	--	--	--	492
100	28	6	40/60/75	17	06/84	3	.04/3	154	360	7.5	493
210	--	--	--	98	05/84	--	--	205	510	7.6	494
180	80	--	--	90	06/84	--	--	--	760	7.6	495
55	--	--	--	29	05/84	--	--	239	520	7.3	496
90	20	6	65/81	--	--	10	--	--	--	--	497
105	22	6	--	51	05/83	--	--	205	510	7.6	498
170	135	6	--	71	05/84	--	--	171	330	7.7	499
141	120	6	135	90	01/80	15	--	--	--	--	500
223	67	4	--	--	--	13	.29/13	--	--	--	501
240	240	6	200/232	--	--	--	--	--	--	--	502
185	152	6	160	--	--	8	--	--	--	--	503
245	246	4	215/230	170	06/84	--	--	--	--	--	504
141	127	4	91/111	--	--	8	.40/8	--	--	--	505
--	--	--	--	40	06/84	--	--	342	900	7.2	506
145	51	6	103/119/120	--	--	30	--	--	--	--	507
68	21	6	--	39	06/84	20	--	239	600	7.2	508
308	40	6	215/287	--	--	8	--	--	--	--	510
--	--	--	--	204	10/84	--	--	--	--	--	512
126	30	6	123	--	--	13	--	--	--	--	514
107	93	6	77/92/103	61	06/84	65	--	--	490	7.2	516
221	39	6	99/210	--	--	8	--	239	675	7.2	518
125	--	--	--	47	06/84	--	--	376	775	7.0	520
88	--	--	--	23	01/83	--	--	239	560	7.0	522
115	--	--	--	26	06/84	80	--	205	540	7.5	524
--	--	--	--	--	--	--	--	203	590	7.4	526
125	33	6	49/111	21	06/84	--	--	--	--	--	528
--	--	--	--	82	06/84	--	--	393	850	6.9	530
167	--	--	--	44	06/84	--	--	85	280	7.4	532
--	--	--	--	44	06/84	--	--	--	--	--	534
110	--	--	--	--	--	1	--	--	--	--	536

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Ba 538	4016-7821	P. Fox	James R. Miller	1980	H	1,450	F	Oba
541	4059-7827	--	--	--	H	--	H	Єg/dlmt
600	4037-7815	Harry Briggs	--	1981	H	1,095	S	Oba/lmsh
601	4039-7812	John Updike	--	--	U	830	V	Oba/lmdm
602	4032-7816	Dave Alberter	Harold E. Ritchey	1972	H	1,170	V	Ocl/lmsh
603	4034-7815	Wiggers	W.R. Parks, Jr.	1975	H	1,120	V	Ocl/lmsh
604	4033-7815	Glenn Allbright	--	--	S	1,080	V	Ocl/lmsh
605	4033-7816	John Rizzo	Fred D. Albright	1976	H	1,140	V	Ocl/lmsh
606	4035-7816	Byron Kirkum	Wiley L. Gray	1974	H	1,130	V	Ocl/lmsh
607	4034-7815	Robert Black	--	1972	H	1,050	V	Oba/lmdm
608	4036-7815	J. McCutchern	James R. Miller	1976	H	1,185	V	Ocl/lmsn
609	4035-7815	Frank Fleck	James R. Miller	1974	H	1,160	V	Onl/lmsn
610	4035-7813	Albert Schoenberger	--	1979	H	950	U	Ocl/lmsh
611	4037-7811	Torrence Yothers	James R. Miller	--	H	1,105	V	Oba/lmdm
612	4036-7812	William Black	--	--	U	1,140	V	Oba/lmdm
613	4037-7813	Charlie Robison	Harold E. Ritchey	1983	H	1,140	V	Onl/lmdm
614	4035-7816	Sinking Valley	--	--	H	1,120	V	Oba/lmdm
615	4036-7814	Tom Crawford	--	1930	H	1,100	U	Onl/lmsn
616	4035-7814	Senberg	--	1972	H	1,040	V	Ocl/lmdm
617	4036-7812	W. Adams	--	--	H	900	V	Ocl/lmsh
618	4031-7811	Vincent Leibal	--	1979	H	1,040	U	Oba/lmdm
619	4030-7813	William Bigelow	--	--	S	1,140	V	Onl/lmsn
620	4030-7812	James Saylor	Harold E. Ritchey	1964	S	1,060	U	Onl/lmsn
621	4030-7810	R. Fischer	William Diehl	--	S	1,010	V	Oba/lmdm
623	4037-7812	Charles Hoover	--	--	U	1,150	V	Onl
624	4038-7811	Michael Yeaton	Donald W. Graham	1978	H	840	V	Ocl/lmsh
625	4038-7814	Richard Koch	James P. Miller, II	--	H	1,140	S	Oba/lmdm
626	4038-7813	Joe Smith	--	--	U	1,095	V	Onl/lmsn
627	4037-7813	Mabel Blacd	--	--	U	1,070	S	Onl/lmdm
628	4038-7814	Richard Koch	James P. Miller, II	1985	H	1,140	S	Oba/lmsm
Ce 94	4042-7756	Penn State University	--	1961	H	1,226	V	Ocl/lmsn
95	4048-7752	Penn State University	--	1962	U	1,092	V	Єgl/dlmt
96	4048-7751	Penn State University	--	1962	U	1,130	H	On/dlmt
97	4051-7750	Penn State University	--	1962	P	1,240	H	Єgm/dlmt
98	4050-7752	Penn State University	--	1962	P	1,208	H	Єgm/dlmt
99	4049-7752	Penn State University	--	1963	H	1,038	V	Єgl/dlmt
101	4048-7752	Penn State University	--	1965	P	1,080	V	Єgm/dlmt
102	4048-7752	Penn State University	--	1938	P	1,065	V	Єgl/dlmt
103	4047-7752	Penn State University	PA Drilling Company	1972	U	1,190	V	On/dlmt
106	4047-7751	Penn State University	--	1938	P	1,161	S	On/dlmt
107	4047-7751	Penn State University	--	1938	U	1,161	S	On/dlmt
114	4049-7751	Penn State University	--	1948	P	1,042	V	Єgl/dlmt
116	4049-7752	Penn State University	--	1948	U	1,092	V	Єgl/dlmt
117	4049-7752	Penn State University	--	1949	P	1,076	V	Єgl/dlmt
118	4045-7757	U.S. Geological Survey	Russell R. Brooks	1967	O	1,150	V	Єgl/dlmt
119	4046-7757	PA Game Commission	Moody Drilling Co., Inc.	1970	R	1,215	V	Єgl/dlmt
129	4049-7740	Centre Hall Borough	--	1973	U	1,275	V	Obf/dlmt
132	4045-7754	Kenneth Bennet	--	1960	H	1,225	V	Єgm/dlmt
133	4049-7757	Centre Co. Assoc.	--	1958	P	1,320	H	Obf/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (μS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
308	290	4	186/250	--	--	30	--	--	--	--	538 Ba
181	181	6	--	135	09/83	--	--	--	--	--	541
--	20	6	--	48	07/84	16	--	239	400	7.0	600
--	--	--	--	10	07/84	--	--	--	--	--	601
131	28	6	50	2	08/84	3	--	137	225	7.1	602
110	63	6	104	--	--	10	1.00/10	154	420	--	603
380	--	--	--	53	08/84	--	--	205	420	--	604
340	21	6	183/320	118	08/84	5	--	222	420	--	605
180	20	6	45/130	31	08/84	5	--	171	380	--	606
43	--	6	--	4	08/84	--	--	256	750	--	607
150	21	6	65/130	35	08/84	15	--	256	950	--	608
380	--	6	--	48	08/84	--	--	239	450	--	609
85	--	6	--	15	08/84	--	0.23/6.8	274	830	--	610
105	--	6	--	48	08/84	--	--	--	--	--	611
105	--	--	--	--	08/84	--	--	--	--	--	612
250	250	4	--	101	08/84	--	--	222	570	--	613
--	--	--	--	22	08/84	--	--	--	--	--	614
125	90	6	--	15	08/84	--	--	222	400	--	615
350	--	6	--	84	08/84	--	--	239	415	7.6	616
50	--	--	--	6	08/84	--	--	154	330	6.9	617
275	6	6	60/275	37	08/84	4	--	239	870	--	618
--	--	6	--	82	08/84	--	3.0/5	257	736	--	619
210	--	6	--	107	08/84	10	--	154	431	--	620
285	--	6	--	107	08/84	--	--	7	736	--	621
92	--	6	--	37	09/84	--	--	--	--	--	623
95	14	6	70	3	09/84	10	--	--	639	--	624
285	--	6	--	25	09/84	--	--	239	682	7.2	625
--	--	--	--	48	09/84	--	--	--	--	--	626
270	--	6	--	64	09/84	--	--	--	--	--	627
--	--	--	--	10	05/85	--	--	--	--	--	628
200	135	6	--	150	01/61	25	.14/25	--	--	--	94 Ce
400	32	12	--	94	--	60	.46/60	--	--	--	95
375	26	7	--	156	--	15	.18/15	--	--	--	96
340	98	6	--	305	--	--	5.8/70	120	--	--	97
267	105	6	--	--	--	27	--	--	--	--	98
310	64	12	--	45	01/63	500	15/500	103	--	8.3	99
400	40	12	--	98	08/66	--	13/--	112	279	8.1	101
330	39	12	--	30	--	--	21/485	102	--	--	102
400	32	8	35/83/120/250	95	01/72	--	.52/130	276	497	7.7	103
340	--	--	--	161	--	458	13/458	200	--	--	106
405	40	12	--	158	--	490	26/490	205	--	--	107
220	53	12	165/212	100	10/48	--	.11/400	156	--	7.8	114
230	43	10	--	92	12/48	450	9.0/300	92	--	--	116
336	34	12	--	50	01/49	--	29/450	120	--	--	117
130	40	6	--	81	01/67	--	110/19	291	725	--	118
506	179	8	--	152	04/70	--	146/510	64	--	8.0	119
530	61	8	95/150/195/245	115	10/73	--	20/400	--	--	--	129
250	40	8	--	78	10/60	--	9.4/310	--	--	--	132
219	37	6	105/205	105	--	--	--	260	--	7.3	133

Table 1.--Record of wells--Continued

Well location Number	Well location Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ce 142	4047-7756	PA Game Commission	--	1894	U	1,351	S	Єgl/dlmt
143	4047-7752	State College Borough	--	1938	U	1,220	H	On/dlmt
144	4045-7749	State College Borough	--	1940	U	1,230	S	Obf/dlmt
145	4046-7750	State College Borough	--	1948	P	1,075	V	On/dlmt
146	4046-7750	State College Borough	--	1950	P	1,075	V	On/dlmt
149	4046-7750	State College Borough	--	1960	P	1,080	V	On/dlmt
152	4046-7750	State College Borough	--	1964	P	1,075	V	On/dlmt
154	4047-7756	State College Borough	--	1964	U	1,351	S	Єgl/dlmt
155	4047-7756	State College Borough	--	1967	U	1,360	S	Єgl/dlmt
156	4047-7757	State College Borough	--	1966	U	1,308	V	Єgl/dlmt
157	4047-7757	State College Borough	--	1968	U	1,330	V	Єgl/dlmt
163	4046-7749	State College Borough	Moody Drilling Co., Inc.	1969	P	1,068	V	On/dlmt
164	4046-7750	State College Borough	Moody Drilling Co., Inc.	1969	U	1,062	V	On/dlmt
165	4046-7750	State College Borough .	Moody Drilling Co., Inc.	1969	U	1,064	V	On/dlmt
172	4056-7742	H.R. Imbt, Inc.	Moody Drilling Co., Inc.	1972	N	880	V	Єgl/dlmt
176	4045-7751	Penn State University	--	1970	H	1,115	V	Oa/lmsn
179	4043-7754	Cedar Hill Water Co.	Oscar Dearmit	1966	P	1,390	S	Ocn/lmsn
181	4052-7739	Centre Hall Borough	--	1968	U	1,340	S	Obl/lmsn
183	4052-7738	Centre Hall Borough	--	1969	U	1,265	V	Obl/lmsn
184	4052-7739	Centre Hall Borough	--	1969	U	1,350	S	Ocn/lmsn
188	4053-7750	Continental Courts, Inc.	Oscar Dearmit	1972	P	900	V	Obf/dlmt
190	4047-7752	Penn State University	Moody Drilling Co., Inc.	1969	U	1,150	V	On/dlmt
200	4051-7746	Corning Glass Company	Russell R. Brooks	1966	U	1,005	V	Obf/dlmt
201	4051-7746	Corning Glass Company	Russell R. Brooks	1967	U	980	V	Obf/dlmt
202	4049-7748	Nease Chemical Company	Russell R. Brooks	1967	Z	1,154	S	Obf/dlmt
203	4049-7748	Nease Chemical Company	Russell R. Brooks	1967	Z	1,125	S	Obf/dlmt
205	4046-7755	L. Nixon	--	1966	I	1,215	V	On/dlmt
208	4055-7726	Rebersburg Water Co.	Russell R. Brooks	1965	P	1,480	S	Ocn/lmsn
213	4044-7757	Rock Spring Water Co.	Gilbert R. Zechman	1967	P	1,120	V	Єgl/dlmt
219	4047-7752	Penn State University	--	1974	U	1,150	V	On/dlmt
220	4052-7738	Centre Hall Borough	--	1969	U	1,300	V	Obl/lmsn
222	4049-7740	Centre Hall Borough	--	1972	U	1,280	V	Obf/dlmt
223	4046-7749	State College Borough	Moody Drilling Co., Inc.	1968	U	1,070	V	On/dlmt
227	4051-7749	PA Fish Commission	Ehmke Well Drillers	1975	Z	1,005	V	Єgm/dlmt
228	4051-7749	PA Fish Commission	Ehmke Well Drillers	1975	Z	1,010	V	Єgm/dlmt
229	4053-7747	PA Fish Commission	Ehmke Well Drillers	1975	Z	840	V	Єgl/dlmt
230	4050-7746	Rockview Correctional Institution	Moody Drilling Co., Inc.	1966	U	1,150	S	Obf/dlmt
231	4047-7751	Penn State University	--	1978	P	1,180	S	On/dlmt
232	4050-7736	Norse Paddle Company	Gilbert R. Zechman	1977	N	1,200	V	Obl/lmsn
238	4044-7801	M. Frysinger	Oscar Dearmit	1976	H	1,205	S	Os/lmsn
240	4044-7800	Country Side Nursery	--	1979	H	1,245	S	Os/lmsn
247	4051-7735	R. Gorman	Gilbert R. Zechman	1979	H	1,120	S	Obl/lmsn
258	4052-7749	Howard Stealey	Gilbert R. Zechman	1977	H	1,050	S	On/lmsn
291	4050-7742	Vern Coontz	Gilbert R. Zechman	1974	H	1,378	V	Obf
296	4054-7743	Leo Juenst	--	1978	H	1,055	H	Obf/lmsn
299	4054-7743	R. Payne	New Way Drilling, Inc.	1978	H	1,020	S	Oa
300	4054-7743	R. Payne	New Way Drilling, Inc.	1977	H	1,015	V	Oa
345	4050-7750	G. Stocker	Oscar Dearmit	1979	H	1,080	H	Os/lmsn

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
366	284	10	--	322	--	--	79/140	--	--	--	142 Ce
603	10	16	--	195	12/38	575	19/575	190	--	7.6	143
264	174	6	--	25	06/40	350	18/350	78	--	--	144
165	72	12	130	9	--	--	143/--	190	--	8.0	145
165	72	12	--	11	11/50	--	600/200	215	--	7.6	146
155	83	14	--	13	--	--	236/650	203	383	7.6	149
142	82	12	--	30	11/64	--	109/420	208	--	7.4	152
453	286	8	--	362	--	350	136/350	--	--	--	154
450	297	10	--	404	--	7	0.13/7	--	--	--	155
500	359	10	340/362	350	--	--	192/725	--	--	--	156
505	434	16	379/400	369	01/68	--	144/495	--	--	--	157
228	--	--	--	14	09/70	--	69/500	206	372	7.7	163
280	--	--	--	8	09/70	--	152/500	192	378	7.9	164
260	--	--	--	6	01/69	--	525/200	194	382	7.9	165
304	164	8	--	25	07/72	--	9.4/980	--	--	--	172
88	20	8	56/72/84	52	05/70	--	.93/20	--	--	--	176
185	22	6	19/103/175	40	11/66	10	.07/10	--	--	--	179
300	110	6	220/235	160	11/68	2	.02/2	--	--	--	181
338	74	6	160/235	160	01/69	30	.17/30	--	--	--	183
350	80	6	220/260/320	150	09/69	7	.04/7	--	--	--	184
40	29	6	30	10	01/72	100	3.3/100	--	--	--	188
275	165	12	20/60/100	114	06/69	--	7.8/500	216	--	7.4	190
175	36	6	140/168	62	09/66	15	.13/15	--	--	--	200
250	25	6	133/196/242	18	01/67	10	.04/10	--	--	--	201
150	74	6	99/126	70	04/67	6	.08/6	--	--	--	202
70	38	6	50	14	04/67	130	2.4/130	--	--	--	203
325	217	6	--	111	09/66	56	.66/56	--	--	--	205
350	72	6	--	23	08/65	--	.62/60	--	--	--	208
322	60	8	--	25	01/67	100	10.0/100	80	--	7.9	213
399	170	18	176/200/208	118	01/74	--	11/600	--	--	--	219
300	69	6	80/130	190	05/69	2	.02/2	--	--	--	220
415	75	12	--	152	02/72	50	.25/50	213	--	7.7	222
242	22	8	30/62/195	12	01/69	--	110/500	186	--	7.8	223
100	37	18	--	5	05/75	1,600	53/600	--	--	--	227
100	24	18	41/85	14	06/75	--	93/956	--	--	--	228
125	36	16	--	10	04/75	--	380/ --	--	--	--	229
420	125	6	--	105	01/68	12	--	--	--	--	230
405	118	8	--	65	01/78	600	40/600	--	--	--	231
201	130	6	148/196	70	05/77	30	--	--	--	--	232
125	100	6	120	6	07/80	10	--	137	290	7.7	238
210	174	6	205	115	07/80	40	--	171	420	7.8	240
201	40	6	74/190	57	08/80	35	--	205	390	7.5	247
326	130	6	262/320	152	10/80	7	--	239	310	7.4	258
326	60	6	97/280/320	159	10/80	5	--	430	222	7.4	291
210	25	6	--	131	10/80	7	--	291	650	7.7	296
180	106	6	156/174	125	11/78	10	1.4/5.5	274	590	--	299
120	55	6	118	90	11/77	10	.50/10	--	--	--	300
230	168	6	220	190	11/80	8	--	--	--	--	345

Table 1.--Record of wells--Continued

Well location								
Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ce 348	4050-7747	Oxegen Burdett	Oscar Dearmit	1979	H	1,120	V	Obf/lmsn
355	4057-7742	K. Ripka	Oscar Dearmit	1978	H	1,025	S	Ocn
358	4058-7739	Dean Rogers	Oscar Dearmit	1977	H	900	S	Obf
372	4055-7728	True Sheats	Russell R. Brooks	1975	H	1,250	V	Ocn/lmsh
395	4047-7740	N. Cronmarty	Oscar Dearmit	1980	H	1,185	V	Or/shle
399	4049-7740	Morton Buildings	Oscar Dearmit	1981	N	1,295	V	Ocn/lmsn
400	4049-7743	Melvin Dutrow	Oscar Dearmit	--	H	1,270	S	Obf/dlmt
401	4045-7752	Sports Car Prep. Co.	Oscar Dearmit	1979	C	1,200	S	On/dlmt
402	4045-7754	Don Grubb	Oscar Dearmit	1976	H	1,255	V	Єgm/dlmt
403	4046-7754	H. Pressler	Oscar Dearmit	1982	H	1,280	V	Os/lmsn
404	4045-7802	G. Reed	Oscar Dearmit	1982	H	1,230	S	Єgl/dlmt
405	4045-7802	Rapp	--	1984	H	1,250	S	Єgl/dlmt
406	4046-7802	Robert Neff	Oscar Dearmit	1976	H	1,250	V	Obf/dlmt
407	4048-7756	Hawbaker	Oscar Dearmit	1981	H	1,300	V	Єgl/dlmt
408	4048-7757	Steve Dubois	--	1978	N	1,335	S	Єgl/dlmt
409	4048-7757	Steve Dubois	Oscar Dearmit	1975	U	1,305	V	Єgl/dlmt
410	4049-7755	Denise Desousa	Oscar Dearmit	1982	H	1,160	W	Єgl/dlmt
411	4048-7757	Louis Glantz	Oscar Dearmit	1980	H	1,240	V	Єgl/lmdm
412	4049-7757	E. Duffus	Oscar Dearmit	1983	H	1,320	V	Ocn/lmsn
413	4047-7749	Koch Funeral Home	Oscar Dearmit	1978	C	1,140	V	On/dlmt
414	4047-7747	Glenn Spicer	Oscar Dearmit	1982	H	1,100	S	Oa/lmsn
415	4048-7749	C. Exarchos	Oscar Dearmit	1983	C	1,020	V	Obl/lmsn
416	4049-7749	Penn State University	Oscar Dearmit	1981	U	960	V	On/dlmt
417	4046-7752	G. Douglas	Oscar Dearmit	1981	H	1,185	V	On/dlmt
418	4050-7747	A. Kyper	Oscar Dearmit	1980	H	1,180	H	Obf/dlmt
419	4050-7749	G. Klair	Oscar Dearmit	1982	S	960	V	Oa/lmsn
420	4051-7750	University Airport	--	--	N	1,235	V	Єgm/dlmt
421	4051-7751	D. Smeltzer	Oscar Dearmit	1983	H	1,080	S	Os/lmsn
422	4053-7748	Roy Miller	Gilbert R. Zechman	1978	H	1,010	V	On/dlmt
423	4052-7749	M.B. Gilpin	--	--	H	1,090	V	Os
424	4048-7746	Tom Stephens	Oscar Dearmit	1980	H	1,290	S	Obf/dlmt
425	4048-7748	Tom Moyer	Oscar Dearmit	1980	H	1,320	S	Obl/lmsn
426	4051-7745	Stoner's Engine	Oscar Dearmit	1982	C	980	V	Obf/lmdm
427	4052-7745	J. Gray	Oscar Dearmit	1981	U	880	S	On/dlmt
428	4052-7744	Centre County Vo-Tech	--	1967	T	1,090	F	Obf/dlmt
429	4053-7743	Centre County Vo-Tech	Oscar Dearmit	1982	U	1,060	V	Obf/dlmt
430	4055-7744	Tele-Media Corp.	Oscar Dearmit	1983	C	980	V	Obf/lmdm
431	4052-7752	Elizabeth McMurtrie	Oscar Dearmit	1983	H	1,140	U	Ocn/lmsh
433	4045-7757	W. Peters	Oscar Dearmit	1983	H	1,110	V	Єgm/dlmt
434	4044-7800	E. Barto	Oscar Dearmit	1984	H	1,330	V	Єgm/dlmt
435	4044-7801	E. Guenot	Oscar Dearmit	1984	H	1,245	V	Os/lmdm
436	4043-7801	Kenneth Stover	Oscar Dearmit	1976	H	1,140	V	Os/lmdm
437	4046-7755	Joe Noll	Oscar Dearmit	1983	H	1,220	V	On/dlmt
438	4047-7752	R. Wilkinson	Oscar Dearmit	1983	I	1,180	V	On/dlmt
439	4051-7749	PA Fish Commission	Ehmke Well Drillers	1975	Q	920	V	Єgm/dlmt
440	4052-7747	PA Fish Commission	Ehmke Well Drillers	1975	Q	830	V	Єgl/dlmt
441	4045-7753	Roy Stewart	Oscar Dearmit	1984	H	1,225	F	On/dlmt
442	4048-7751	Penn State University	Oscar Dearmit	1984	U	1,135	V	Os/lmdm
443	4049-7750	Penn State University	--	--	U	990	U	On/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
290	120	6	280	117	11/80	20	--	205	470	--	348 Ce
317	137	5	212	139	10/80	15	--	205	430	--	355
65	48	6	62	56	10/80	30	--	291	605	7.7	358
101	48	6	62/84	32	07/84	20	0.30/20	205	660	7.4	372
126	40	6	--	25	05/84	25	--	290	570	7.4	395
175	60	6	--	61	05/84	12	.18/4.0	410	778	7.2	399
300	20	6	--	134	05/84	--	--	324	658	7.5	400
146	111	6	136	87	06/84	15	--	325	848	--	401
210	100	6	210	95	06/84	45	2.3/10	308	975	7.6	402
270	233	6	260	125	04/82	30	.49/8	171	328	8.0	403
297	307	6	300	92	06/84	150	7.0/7	137	249	8.1	404
--	--	--	--	109	06/84	--	--	--	--	--	405
182	20	6	80	18	06/84	3	--	274	800	--	406
325	316	6	315	254	06/84	60	--	103	190	7.5	407
325	45	6	--	142	06/84	--	--	137	308	--	408
65	--	--	--	4	06/84	13	--	--	--	--	409
218	213	6	208	124	06/84	60	9.7/8.9	171	325	--	410
145	137	8	135	--	--	75	--	205	430	7.6	411
284	106	6	280	79	06/84	6	--	103	308	--	412
165	51	6	160	86	06/84	30	--	--	--	--	413
125	100	6	115	84	06/84	50	16/7.7	257	590	7.7	414
175	90	6	170	46	06/84	55	1.5/55	274	650	7.2	415
209	71	10	53/61/82/102	25	06/84	1,700	137/100	68	326	7.4	416
300	248	6	290	81	06/84	80	--	205	420	7.1	417
300	315	6	290	162	06/84	30	11/4.4	188	635	6.6	418
110	100	6	100	19	06/84	120	--	274	658	6.7	419
299	--	--	--	234	06/84	--	--	205	285	--	420
173	151	6	163	129	06/84	15	--	205	475	--	421
451	247	6	405/440	86	06/84	5	--	239	475	6.6	422
--	--	--	--	178	06/84	--	--	188	529	6.9	423
105	57	6	95	60	06/84	6	--	222	466	7.7	424
229	42	6	219	73	06/84	5	--	222	--	--	425
166	110	--	156	41	06/84	60	--	291	628	--	426
250	86	--	240	138	06/84	50	--	--	--	--	427
225	79	6	175/197/202	133	06/84	15	--	274	608	--	428
150	140	6	140	92	06/84	30	--	--	--	--	429
600	61	6	590	14	06/84	1	--	--	--	--	430
575	25	6	565	22	06/84	--	--	120	860	--	431
60	51	6	50	21	06/84	60	--	137	360	7.6	433
300	294	6	--	195	06/84	30	--	120	515	7.2	434
181	158	6	156/162/180	123	06/84	30	--	--	--	--	435
97	91	6	50/91	76	06/84	--	--	137	660	7.0	436
525	111	6	515	82	06/84	3	--	291	685	7.5	437
150	106	6	146	60	06/84	6	.33/8.7	291	610	7.9	438
125	36	16	42/74/104	19	06/84	--	380/--	171	773	--	439
100	37	18	45/70	84	06/84	--	53/600	120	560	7.3	440
225	154	6	212/224	90	06/84	60	--	--	--	--	441
135	43	6	110	30	06/84	6	--	--	--	--	442
405	405	8	--	53	06/84	800	--	309	--	7.5	443

Table 1.--Record of wells--Continued

Well location								
Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ce 444	4049-7753	Penn State University	--	--	U	1,140	V	Ꞓgl/dlmt
445	4049-7752	Penn State University	--	--	U	1,075	V	Ꞓgl/dlmt
446	4045-7750	C. Antle	Oscar Dearmit	1981	H	1,110	V	On/dlmt
447	4045-7748	Peter Pepe	Oscar Dearmit	1984	H	1,240	S	Obf/dlmt
448	4043-7754	M. Sevick	Oscar Dearmit	1964	U	1,250	V	Ocl/lmsh
449	4045-7758	C. Brooks	Oscar Dearmit	1982	H	1,195	W	Ꞓgl/dlmt
450	4042-7800	Richard Fye	--	--	H	1,175	V	On/dlmt
451	4043-7801	Brusler	Oscar Dearmit	--	H	1,120	V	Ꞓgl/dlmt
452	4043-7802	Eric Myers	Oscar Dearmit	1968	S	1,175	V	On/dlmt
453	4046-7749	Galen Dreibelbis	Oscar Dearmit	1978	R	1,130	V	Oa/lmsn
454	4044-7757	Jay Harpster	Gilbert R. Zechman	1976	H	1,130	V	Ꞓgl/dlmt
455	4046-7752	Ferguson Township	Oscar Dearmit	1982	U	1,175	V	On/dlmt
464	4044-7754	Henry Dreibelbis	Oscar Dearmit	1958	U	1,290	V	Oa/lmsn
472	4044-7757	Todd Giddings	Oscar Dearmit	1977	H	1,270	S	Ꞓgl/dlmt
473	4042-7756	Penn State University	Oscar Dearmit	1972	I	1,230	V	Ocl/lmdm
474	4044-7801	Fred Herman	Oscar Dearmit	1983	H	1,155	S	Ꞓgl/dlmt
475	4048-7742	Meadows Clinic	Oscar Dearmit	1983	T	1,245	V	Obl/lmdm
476	4050-7740	Harold Bierly	--	1967	U	1,270	V	Ocn/lmsh
477	4046-7743	J. Smith	Oscar Dearmit	1983	H	1,375	S	Ocn/lmsh
478	4047-7743	D. Putman	Oscar Dearmit	1983	H	1,265	S	Obf/dlmt
479	4046-7746	C. Aikens	--	--	U	1,260	U	Or/shle
480	4047-7741	T. Kerr	Oscar Dearmit	1983	S	1,205	U	Ocn/lmsh
481	4049-7740	H. Williams	Oscar Dearmit	1981	H	1,280	V	Obf/dlmt
482	4049-7743	William Kinser	Oscar Dearmit	1982	U	1,270	V	Obf/dlmt
483	4047-7745	Douglas Kennedy	Oscar Dearmit	1981	H	1,170	U	Obf/dlmt
484	4049-7738	Chris Palmer	--	--	H	1,205	U	Obf/dlmt
485	4050-7736	C. Wells	Oscar Dearmit	1980	H	1,165	U	Obl/lmdm
486	4049-7738	Glenn Wolfe	--	--	N	1,265	V	Obf/dlmt
487	4049-7739	Carl Smith	Oscar Dearmit	1981	H	1,250	V	Obl/lmdm
488	4050-7742	Ken Long	Oscar Dearmit	1983	H	1,390	V	Obf/dlmt
489	4048-7744	P. Bright	Oscar Dearmit	1983	H	1,200	U	Obf/dlmt
490	4048-7743	Dunkelbarger	Oscar Dearmit	1983	H	1,315	S	Ocn/lmdm
491	4049-7741	John Dashem	--	--	U	1,270	V	Obl/lmdm
492	4050-7737	St. Kateri Cath. Church	Oscar Dearmit	1982	T	1,200	V	Obl
493	4046-7747	B. Knox	Oscar Dearmit	1983	H	1,255	S	Obl/lmsh
494	4047-7742	Corvette America	Gilbert R. Zechman	1977	N	1,290	V	Obf/dlmt
495	4047-7738	Walter Geary	Douglas C. Klinger	1973	H	1,240	S	Ocn/lmdm
496	4046-7739	Louis Martin	--	--	H	1,250	V	Ocn/lmdm
497	4051-7735	Walter Tomasch	Oscar Dearmit	1983	H	1,230	S	Ocn/lmdm
498	4052-7733	J. Houser	Gilbert R. Zechman	1980	H	1,215	V	Ocn/lmdm
499	4050-7733	Elmer Queer	Oscar Dearmit	1960	H	1,080	V	Ocn/lmsh
500	4050-7735	D. Steiger	Oscar Dearmit	1983	H	1,300	U	Or/shle
501	4051-7733	S. Boop	Oscar Dearmit	1980	H	1,100	V	Ocn/lmsh
502	4051-7732	Kenneth Haupt	Gilbert R. Zechman	1976	H	1,240	V	Ocn/lmsh
503	4051-7737	J. Kohler	Gilbert R. Zechman	1981	H	1,300	H	Ocn/lmsh
504	4052-7733	William Sweely	Gilbert R. Zechman	1981	H	1,225	V	Ocn/lmsh
505	4054-7733	C. Mason	Oscar Dearmit	1982	H	1,305	V	Obl/lmdm
506	4055-7732	Melvin Miller	Oscar Dearmit	1963	N	1,335	V	Ocn/lmsh
507	4056-7727	James Dillen	Oscar Dearmit	1982	H	1,340	U	Ocn/lmsh

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
289	--	4	--	97	06/84	--	--	70	--	8.4	444 Ce
200	89	6	--	61	06/84	--	--	110	--	7.6	445
150	128	6	140	46	06/84	70	--	137	785	7.1	446
150	127	6	140	85	06/84	10	0.2/4	--	538	7.1	447
50	50	6	--	6	06/84	--	--	--	--	--	448
365	--	6	--	190	06/84	--	--	86	300	7.2	449
115	--	--	--	79	06/84	--	--	222	398	6.8	450
23	--	--	--	14	07/84	--	--	274	720	--	451
330	--	--	--	111	07/84	--	--	154	790	7.2	452
95	80	6	90	38	06/84	80	--	188	622	--	453
160	125	6	145	1	06/84	50	--	--	--	--	454
110	49	6	100	82	06/84	--	--	--	--	--	455
217	25	6	--	71	06/84	--	--	--	--	--	464
285	82	6	180/282	154	06/84	15	--	68	155	--	472
--	--	--	--	35	07/84	--	--	205	550	--	473
64	54	6	60	22	07/84	10	--	171	710	7.3	474
225	141	6	197/224	73	07/84	--	7.0/60	--	--	--	475
179	15	--	93	91	07/84	32	--	--	--	--	476
158	135	6	150	75	07/84	12	--	137	495	--	477
230	57	6	220	86	07/84	60	--	256	600	7.6	478
35	--	--	--	3	07/84	--	--	--	--	--	479
250	196	6	200/240	90	07/84	6	--	120	330	--	480
175	1,562	6	165	57	07/84	60	--	222	632	7.2	481
250	68	6	240	90	07/84	120	--	--	--	--	482
150	86	6	140	57	07/84	17	--	--	--	--	483
--	--	--	--	99	07/84	--	--	222	632	7.1	484
150	95	6	140	60	07/84	8	.58/9.9	222	682	--	485
180	--	--	--	80	07/84	--	--	359	850	7.3	486
150	60	6	140	24	07/84	30	.96/6	256	783	--	487
332	225	6	250	80	07/84	15	--	171	448	7.3	488
168	101	6	158	35	07/84	8	--	205	500	7.1	489
265	50	6	--	34	07/84	5	--	256	527	7.3	490
100	--	--	--	62	07/84	--	--	--	--	--	491
183	175	6	173	99	07/84	60	--	--	--	--	492
450	38	6	440	145	07/84	20	--	137	441	7.0	493
201	106	6	122/200	23	07/84	25	.95/9	274	673	--	494
115	--	--	--	45	07/84	30	--	256	--	6.9	495
--	--	--	--	25	07/84	--	--	153	570	--	496
450	100		252/274/343/447	144	07/84	7	--	--	--	--	497
101	40	6	81/89	11	07/84	9	.09/4.5	239	682	--	498
127	20	4	--	7	07/84	--	--	239	660	--	499
298	20	6	240	--	--	--	--	68	315	--	500
251	40	6	140/226	11	07/84	3	--	222	723	--	501
251	41	6	88/242	66	07/84	10	--	274	830	7.5	502
500	40	6	322/409/465/484	178	07/84	6	--	188	880	7.3	503
128	40	6	--	39	07/84	20	--	188	683	7.3	504
250	246	6	240	132	07/84	60	--	239	--	7.6	505
525	12	6	--	46	07/84	--	--	222	660	--	506
175	74	6	165	104	07/84	30	--	120	550	--	507

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Ce 509	4053-7729	R and K Garage	Oscar Dearmit	1980	N	1,190	U	Obl/lmdm
510	4053-7728	L. Corman	Oscar Dearmit	1982	N	1,115	V	Obl/lmdm
511	4054-7726	Robin McCammon	Oscar Dearmit	1981	H	1,240	S	Ocn/lmsh
512	4054-7735	J. Grimes	Oscar Dearmit	1983	H	1,290	V	Obl/lmdm
513	4052-7731	Penns Valley Area School	--	--	T	1,225	V	Obl/lmdm
514	4052-7732	Donald Stover	Russell R. Brooks	1973	H	1,240	V	Obl/lmdm
515	4049-7734	Charles Bronk	--	--	H	1,170	V	Ocn/lmsh
516	4049-7733	Jerry Myers	--	--	N	1,100	V	Ocn/lmsh
517	4052-7731	Larry Schreckengast	--	--	U	1,175	V	Ocn/lmsh
518	4054-7722	Arlington Orndorf	Gilbert R. Zechman	1970	H	1,200	U	Ocn/lmsh
519	4054-7723	M. Carper	Gilbert R. Zechman	1981	N	1,135	U	Ocn/lmsh
520	4050-7738	Tri-Penn United Church of Christ	Gilbert R. Zechman	1977	H	1,240	V	Obl/lmdm
521	4051-7730	Confer	--	--	U	1,100	U	Ocn/lmsh
522	4058-7721	E. Rossman	Oscar Dearmit	1981	H	1,350	V	Ocn/lmsh
523	4058-7717	Frank Westendorf	--	--	H	1,525	V	Or/shle
524	4050-7739	Kurt Eysenbach	Harry Hull	1976	N	1,230	V	Ocn/lmsh
525	4051-7739	Helen Frye	--	--	H	1,280	V	Or/shle
526	4052-7734	William Sharpe	--	--	H	1,200	U	Ocn/lmsh
527	4054-7724	Malvin Vonada	Russell R. Brooks	1975	H	1,245	U	Ocn/lmsh
528	4053-7720	C. Jensen	Gilbert R. Zechman	1982	H	1,280	S	Or/shle
529	4053-7722	Gregg Forhinger	Gilbert R. Zechman	1980	H	1,100	V	Ocn/lmsh
530	4046-7753	Herbert Imbt	--	--	U	1,220	V	On/dlmt
531	4044-7753	Irvin	--	--	U	1,250	V	Oa/lmsh
532	4045-7755	Gilligan	William Houser	1956	N	1,260	V	€gm/dlmt
533	4043-7756	Mary Anders	--	--	U	1,195	V	Obf/dlmt
534	4044-7755	Charlie Campbell	--	--	U	1,255	W	Obf/dlmt
535	4043-7755	John Kocher	--	--	U	1,230	V	Obf/dlmt
536	4043-7755	John Kocher	Lee Dearmit	--	S	1,210	V	Obf/dlmt
537	4042-7758	Dean Harper	--	--	U	1,180	V	Oa/lmsn
538	4043-7757	David Morrow	--	--	U	1,195	V	Obf/dlmt
539	4043-7757	Dreibler	--	--	U	1,250	V	€gl/dlmt
540	4044-7757	James Slick	--	--	U	1,130	V	On/dlmt
541	4043-7758	Wheland	--	--	U	1,105	V	Os/lmsn
542	4043-7759	Marshall Harpster	--	--	N	1,120	U	On/dlmt
543	4042-7759	A. Tinelli	Oscar Dearmit	1982	H	1,140	V	Oa/lmsn
544	4044-7758	Lee Harpster	Lee Dearmit	1970	H	1,120	W	On/dlmt
545	4043-7805	John Nearhoof	--	--	U	1,255	V	€w/dlmt
546	4044-7804	Dale Burns	--	--	H	1,315	V	Oba/lmdm
547	4046-7802	S. Talbert	Oscar Dearmit	1981	H	1,260	S	€gl/dlmt
548	4046-7801	Dan Hughes	--	--	H	1,265	U	Os
549	4042-7757	Penn State University	--	1961	T	1,205	V	Ocl/lmsh
550	4054-7721	Noah Yoder	--	1977	N	1,170	V	Or/shle
551	4055-7722	Eugene Warntz	Gilbert R. Zechman	1981	H	1,200	V	Ocn/lmsh
552	4101-7735	Paul Vonada	--	--	N	980	V	Obf/dlmt
553	4100-7736	Dave Sheats	--	--	H	1,070	V	Obf/dlmt
554	4059-7737	Mildred Baird	--	--	U	980	U	On/dlmt
555	4059-7734	Robert Graves	--	--	H	880	V	On/dlmt
556	4058-7736	Melvin Fravel	--	--	U	910	V	On/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
165	128	6	155	87	07/84	20	6.6/7.9	239	620	--	509 Ce
272	130	6	262	20	07/84	8	--	256	705	--	510
250	43	6	240	32	07/84	4	--	--	--	--	511
167	149	6	165	81	07/84	6	0.26/7.0	171	560	--	512
500	--	8	--	--	--	50	--	188	878	--	513
225	60	6	--	92	07/84	60	--	205	878	6.8	514
--	--	--	--	2	07/84	--	--	205	808	--	515
--	--	--	--	7	07/84	--	--	239	605	--	516
--	--	--	--	2	07/84	--	--	--	--	--	517
494	41	6	25/170/450	65	07/84	5	.15/9.8	222	665	6.7	518
85	40	6	54/60/73	8	07/84	12	--	239	735	--	519
401	40	6	170/370	105	07/84	6	--	274	--	--	520
15	--	--	--	11	07/84	--	--	--	--	--	521
198	43	6	188	21	07/84	10	--	239	370	--	522
145	--	--	--	32	07/84	--	--	--	120	--	523
210	20	6	--	66	07/84	30	--	256	450	--	524
95	--	--	--	18	07/84	--	--	222	400	6.9	525
85	--	--	--	11	07/84	--	--	256	350	7.2	526
152	28	6	75/141/150	40	07/84	12	.11/12	188	375	--	527
101	60	6	64/74/89	21	07/84	13	--	34	100	8.0	528
110	52	6	58	43	07/84	45	--	--	--	--	529
--	--	--	--	95	07/84	--	--	--	--	--	530
187	50	6	--	52	07/84	--	--	--	--	--	531
205	50	6	--	97	07/84	--	--	154	310	--	532
135	--	6	--	17	07/84	--	--	--	--	--	533
75	--	--	--	37	07/84	--	--	--	--	--	534
160	--	--	--	32	07/84	--	--	--	--	--	535
112	--	6	--	12	07/84	--	--	291	670	--	536
105	--	--	--	32	07/84	--	--	--	--	--	537
--	--	--	--	8	07/84	--	--	--	--	--	538
--	--	--	--	1	07/84	--	--	--	--	--	539
--	--	--	--	9	07/84	--	--	--	--	--	540
17	--	--	--	4	07/84	--	--	120	275	--	541
74	--	--	--	21	07/84	25	--	205	385	7.7	542
422	14	6	412	14	07/84	35	--	120	240	7.1	543
65	20	6	--	13	07/84	45	16/30.9	274	450	7.5	544
14	--	--	--	8	07/84	--	--	--	--	--	545
100	21	6	--	23	07/84	--	--	239	455	--	546
215	110	6	205	69	07/84	200	--	137	245	--	547
170	--	--	--	58	07/84	--	--	120	230	--	548
200	--	--	--	52	07/84	25	--	291	660	--	549
80	75	6	--	16	07/84	--	--	103	265	--	550
140	80	6	140	7	07/84	30	--	154	370	7.6	551
--	--	--	--	69	08/84	--	--	256	730	--	552
300	--	6	--	14	08/84	2	--	308	710	--	553
--	--	--	--	1	08/84	--	--	--	--	--	554
52	--	--	--	14	08/84	--	10/3.7	154	320	--	555
35	--	--	--	8	08/84	--	--	85	190	--	556

Table 1.--Record of wells--Continued

Well location Number	Well location Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ce 557	4059-7733	Ronald Denker	--	--	U	860	V	Obf
558	4100-7734	Ronald Mattern	Oscar Dearmit	1983	H	980	V	Ꞓg/dlmt
559	4052-7735	George Friend	--	--	N	1,250	U	Ocn/lmsh
560	4048-7736	Fred Bechtol	--	--	H	1,260	V	Ocn/lmsh
561	4051-7731	Jim Artley	--	--	H	1,160	V	Ocn/lmsh
562	4050-7740	N. Homan	--	1976	H	1,340	S	Ocn/lmsh
563	4048-7739	Herbert Grove	--	1960	N	1,220	V	Obf/dlmt
564	4048-7741	Elwood Houtz	--	1982	H	1,305	V	Obf/dlmt
565	4053-7742	Warner Company	Oscar Dearmit	1982	N	1,030	D	Obl/lmdm
566	4054-7741	Daniel Boob	--	--	U	1,065	V	Obf/lmdm
567	4055-7740	John Lowery	--	--	U	1,085	V	On/dlmt
568	4053-7743	James Crater	--	--	S	1,085	V	Obf/dlmt
569	4048-7753	Dorothy Jodon	--	--	U	1,200	V	Ꞓgm/dlmt
570	4049-7754	Toftrees Country Club	--	--	U	1,200	U	Ꞓgl/dlmt
571	4047-7749	Cent. Hill Country Club	--	--	U	1,030	V	Obf/dlmt
572	4046-7747	Boal Mansion	--	--	U	1,080	V	Obf/dlmt
573	4046-7745	Kenneth Bennett	--	--	H	1,180	V	Ocn/lmsh
574	4047-7746	Richard Stern	--	--	H	1,100	S	Obf/dlmt
575	4051-7729	Charles Spangler	--	--	H	1,040	U	Ocn/lmsh
576	4052-7727	Max Dinges	--	1969	H	1,040	S	Obl/lmsh
577	4052-7729	George Futhey	--	--	S	1,150	V	Ocn/lmsh
578	4053-7723	Steven Hostetler	--	--	S	1,110	S	Ocn/lmsh
579	4053-7724	Rufus Zook	--	--	S	1,160	S	Ocn/lmsh
580	4049-7756	Penn State University	--	--	U	1,140	V	Ꞓgl/dlmt
581	4050-7752	Second Mile	Oscar Dearmit	1982	T	1,145	U	Ꞓgm/dlmt
582	4047-7756	State College Borough	--	--	U	1,355	V	Ꞓgl/dlmt
583	4053-7744	Ronald Weaver	Gilbert R. Zechman	1975	H	1,100	V	Oa/lmsn
584	4054-7744	Elosie Taylor	--	--	H	900	U	Os/lmsn
585	4055-7742	Orin Weaver	--	--	U	910	U	Ꞓgm/dlmt
586	4050-7751	Penn State University	--	--	U	1,060	U	Ꞓgl/dlmt
587	4047-7751	PSU Power Plant	--	1948	U	1,160	V	Oa/lmsn
588	4054-7741	Kermit Rider	--	--	S	1,050	V	On/dlmt
589	4056-7742	Haranin Construction	Oscar Dearmit	1982	N	900	S	Obf/dlmt
590	4051-7728	Dana Harlan	Gilbert R. Zechman	1967	H	1,160	V	Ocn/lmsh
591	4045-7802	Boyd Way	Oscar Dearmit	1982	H	1,210	U	Ꞓgl/dlmt
592	4046-7803	Paul Weaver	--	--	U	1,300	V	Obf/lmsh
593	4047-7801	F. Davidson	--	1945	U	1,330	V	Obf/dlmt
594	4048-7800	John Simpson	--	--	U	1,370	V	Obf/dlmt
595	4047-7758	Paul Brown	--	--	U	1,350	V	Ꞓgl/dlmt
596	4051-7753	V. Dupuis	--	--	S	1,040	V	On/dlmt
597	4055-7741	Benner	--	--	U	1,070	S	Os/lmsn
598	4058-7737	Barry Barner	Gilbert R. Zechman	1976	H	1,045	S	On/dlmt
599	4045-7804	Edith Reese	--	--	S	1,400	S	Or/shle
600	4054-7725	Ed Morton	Russell R. Brooks	1966	H	1,215	V	Ocn/lmsh
601	4053-7725	Rufus Yoder	--	--	S	1,100	U	Ocn/lmsh
602	4052-7726	Christian Zook	--	--	S	1,040	V	Obl/lmdm
603	4053-7727	Bethlehem Steel Co.	--	--	S	1,135	V	Obl/lmdm
604	4054-7744	James Donovan	--	1927	S	1,040	S	On/dlmt
605	4054-7745	Fred Ulmer	--	--	H	1,030	U	Os/lmsn

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
60	--	--	--	9	08/84	--	--	--	--	--	557 Ce
298	140	6	288	83	08/84	2	--	58	170	--	558
--	--	6	--		--	--	--	222	670	--	559
73	60	6	--	10	08/84	--	--	68	150	--	560
35	--	--	--	10	08/84	--	--	274	660	--	561
342	40	6	50/320	17	08/84	2	--	205	450	--	562
205	20	6	--	38	08/84	--	--	--	460	2.0	563
150	95	6	--	40	08/84	--	--	188	330	--	564
225	155	6	170/200/215	54	08/84	60	--	256	620	--	565
--	--	--	--	8	08/84	--	--	--	--	--	566
--	--	--	--	2	08/84	--	--	--	--	--	567
256	--	6	--	40	08/84	--	--	308	955	7.5	568
--	--	6	--	98	09/84	--	--	--	--	--	569
280	--	8	--	23	09/84	--	--	--	--	--	570
300	--	10	--	3	09/84	--	--	--	--	--	571
--	--	--	--	16	09/84	--	--	--	--	--	572
105	--	6	--	12	09/84	--	--	257	665	7.3	573
--	--	6	--	29	09/84	--	--	205	573	7.4	574
13	--	--	--	9	10/84	--	--	120	593	--	575
75	50	6	--	23	10/84	25	--	171	539	--	576
--	--	6	--	17	10/84	--	--	222	763	7.1	577
52	20	6	--	19	10/84	20	--	205	647	--	578
100	--	6	--	52	10/84	--	--	188	638	7.1	579
744	450	6	--	40	10/84	--	--	--	--	--	580
220	198	6	210	149	10/84	60	--	--	--	--	581
--	--	6	--	306	10/84	--	--	--	--	--	582
425	69	6	212/300/345	202	10/84	6	--	256	946	--	583
101	--	6	--	30	10/84	--	--	205	539	--	584
100	--	6	--	12	10/84	--	--	--	--	--	585
150	--	--	--	51	10/84	--	--	--	--	--	586
357	--	8	--	154	10/84	700	--	--	--	--	587
170	--	6	--	37	10/84	--	--	274	--	7.0	588
100	81	6	--	34	10/84	60	--	188	610	--	589
201	40	6	153	153	10/84	3	--	222	682	7.3	590
123	116	6	113	35	09/84	60	--	103	363	7.9	591
--	--	6	--	16	09/84	--	--	--	--	--	592
37	--	6	--	13	09/84	50	--	--	--	--	593
--	--	--	--	20	10/84	--	--	--	--	--	594
--	--	--	--	7	10/84	--	--	--	--	--	595
74	43	6	--	15	10/84	--	--	154	460	7.7	596
91	--	6	--	86	10/84	--	--	--	--	--	597
326	75	6	200/309	75	10/84	60	--	205	647	7.5	598
60	--	6	--	19	10/84	--	--	68	228	--	599
245	245	6	--	151	10/84	--	--	171	638	6.9	600
71	--	6	--	7	10/84	--	--	222	557	--	601
43	--	6	--	11	10/84	--	--	137	430	7.4	602
--	--	6	--	87	10/84	--	--	291	910	--	603
265	225	6	--	84	10/84	--	--	410	953	7.4	604
300	--	6	--	187	10/84	--	--	308	830	--	605

Table 1.--Record of wells--Continued

Well location								
Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Ce 606	4056-7743	Alice Wian	--	--	H	875	V	Obl/lmdm
607	4059-7737	Robert Conaway	--	--	H	890	V	Obf/lmdm
608	4058-7739	Yarnell Poorman	Lee Dearmit	1964	H	900	V	Obl/lmdm
609	4058-7738	John Esh	--	--	S	1,025	W	Єg/dlmt
610	4052-7728	Bethlehem Steel Co.	--	--	S	1,180	V	Ocn/lmsh
611	4052-7728	Buck Norway	--	--	H	1,050	V	Ocn/lmsh
612	4053-7726	Bethlehem Steel Co.	--	--	U	1,180	U	Ocn/lmsh
613	4051-7753	J. Karl	Oscar Dearmit	1982	H	1,000	U	Єgm/dlmt
614	4051-7753	G. Harshberger	Lee Dearmit	1972	H	1,060	W	Obf/dlmt
615	4057-7723	Dave Swartz	--	--	U	1,290	V	Ocn/lmsh
616	4057-7724	Janis Barnes	--	--	U	1,285	V	Ocn/lmsh
617	4056-7727	Paul Rearick	--	--	U	1,255	V	Obl/lmdm
618	4051-7737	James Grove	--	--	H	1,280	U	Ocn/lmsh
619	4055-7730	Stoltzfus Rep. Shop	--	--	C	1,300	V	Obl/lmdm
620	4055-7731	Elsie Fetterolf	--	--	H	1,280	V	Obl/lmdm
621	4053-7734	W. Rockey	Russell R. Brooks	1971	H	1,335	S	Ocn/lmsh
622	4053-7735	Laron Ilgen	Oscar Dearmit	1978	H	1,220	S	Obl
623	4053-7737	Ray Spayd	Oscar Dearmit	1982	H	1,240	V	Ocn/lmsh
624	4053-7730	Lanny Stover	W.E. Hubler Well	--	--	1,260	U	Ocn/lmsh
625	4059-7732	Steve Grieb	--	--	--	990	U	Ocn/lmsh
626	4058-7734	Bruce Cramer	Oscar Dearmit	--	--	930	V	Obl/lmdm
627	4053-7745	Tom Donavan	--	--	--	880	V	On/dlmt
628	4054-7734	Abe Allebach	--	--	--	1,380	S	Ocn/lmsh
629	4057-7737	Jon Barmhardt	Shoops Well Drilling	--	--	940	V	On/dlmt
630	4057-7736	John Miller	--	--	--	920	V	Oa/lmsn
631	4053-7736	Charles Mothersbaugh	--	--	--	1,270	V	Obl/lmdm
632	4059-7736	Charles Utz	--	--	--	1,080	S	Єg/dlmt
633	4058-7735	Ronald Lee	--	--	--	910	V	On/dlmt
634	4046-7751	M. McLintock	--	--	--	1,185	V	On/dlmt
635	4057-7738	Joe Stringer	--	--	--	1,010	V	Єg/dlmt
636	4052-7733	Joe Stringer	--	--	--	1,200	S	Ocn/lmsn
637	4056-7737	Sand Ridge Farm	--	--	--	960	V	On/dlmt
638	4055-7739	Bill Workman	Oscar Dearmit	--	--	1,060	V	Obl/lmdm
639	4056-7739	Robert Kennis	--	--	--	1,105	S	Єgm/dlmt
640	4052-7745	Budd Smith	--	--	--	1,025	S	Obf/dlmt
641	4055-7738	Walker Twp. Water Co.	Oscar Dearmit	--	--	1,065	V	Obl/lmdm
642	4054-7740	George Zimmerman	--	--	--	1,075	V	Obf/dlmt
643	4052-7743	Richard Bird	--	--	--	1,075	V	Obl/lmdm
644	4054-7742	Murmac Farms	--	--	S	1,070	S	On/dlmt
645	4055-7743	Rodney Musser	--	1982	H	965	U	On/dlmt
646	4057-7741	KOA Campground	Oscar Dearmit	1971	P	1,020	V	Obf/dlmt
647	4058-7740	Robert Haines	Oscar Dearmit	--	H	1,040	S	Obf/lmsm
648	4053-7746	George Decker	--	--	H	1,035	V	Єgm/dlmt
649	4053-7744	Spring Twp. Building	--	--	N	950	V	Oa/lmsn
650	4050-7752	Rocky Kerwin	--	--	H	1,163	S	Єgm/dlmt
651	4049-7739	Lake O.	--	--	H	1,300	H	Obf/dlmt
652	4045-7755	State College Water Auth.	Kohl Brothers	1979	P	1,180	V	Єg/dlmt
653	4045-7755	State College Water Auth.	F.L. Bollinger and Sons	1976	P	1,180	V	Єg/dlmt
654	4045-7755	State College Water Auth.	Kohl Brothers	1979	P	1,180	V	Єg/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
245	--	6	--	58	10/84	--	--	--	--	--	606 Ce
--	--	--	--	14	10/84	--	--	205	728	--	607
48	--	--	--	32	10/84	--	--	--	750	7.3	608
--	--	6	--	14	10/84	--	--	205	763	7.3	609
--	--	6	--	147	10/84	--	--	239	615	--	610
60	--	6	--	8	10/84	--	--	205	565	--	611
--	--	6	--	20	10/84	--	--	--	--	--	612
90	80	6	80	23	10/84	--	--	120	313	7.9	613
250	--	6	--	7	10/84	--	--	103	368	7.7	614
80	--	6	--	27	11/84	--	--	--	--	--	615
320	--	6	--	59	11/84	--	--	--	--	--	616
57	--	4	--	36	11/84	--	--	--	--	--	617
--	--	6	--	74	11/84	--	--	256	628	--	618
150	95	6	--	106	11/84	--	--	222	574	7.6	619
--	--	--	--	94	11/84	--	--	205	660	7.0	620
151	148	6	--	130	11/84	--	--	137	328	--	621
120	40	6	120	62	11/84	--	--	274	--	7.1	622
200	136	6	190	82	11/84	0	0.38/8.9	68	205	7.8	623
400	--	6	--	75	11/84	--	--	205	520	7.6	624
--	--	--	--	3	11/84	--	--	51	133	--	625
85	50	6	80	44	11/84	--	--	120	340	8.4	626
75	--	6	--	40	11/84	--	--	15	1,000	7.2	627
--	--	--	--	8	11/84	--	--	--	--	--	628
125	105	6	--	33	11/84	--	--	239	629	7.3	629
--	--	--	--	14	11/84	--	--	--	--	--	630
120	--	6	--	58	11/84	--	--	256	846	7.2	631
290	100	6	--	110	11/84	--	.05/8.3	137	373	7.3	632
90	--	6	--	34	11/84	--		--	--	--	633
--	--	6	--	175	11/84	--	--	308	955	7.4	634
--	--	--	--	5	11/84	--	--	--	--	--	635
200	--	--	--	41	11/84	--	.05/5	--	725	--	636
140	130	6	--	34	12/84	--	--	--	--	--	637
59	41	6	--	11	12/84	--	--	137	400	7.6	638
250	--	6	--	100	12/84	--	--	68	176	--	639
206	23	6	125	57	12/84	--	--	256	682	7.5	640
250	188	12	72/123	24	12/84	--	--	164	360	7.5	641
260	--	--	--	29	12/84	--	--	222	818	7.3	642
1,075	--	--	--	154	12/84	--	--	205	700	7.4	643
224	--	6	--	93	12/84	--	--	291	910	7.2	644
150	--	6	--	116	12/84	--	--	308	890	7.3	645
185	185	6	--	14	12/84	--	--	120	338	--	646
--	--	6	--	57	12/84	--	--	308	750	--	647
--	--	6	--	65	12/84	--	--	205	745	--	648
120	--	6	--	75	12/84	--	--	--	--	--	649
266	--	--	--	203	05/63	--	--	--	--	--	650
300	--	--	--	94	05/85	--	--	--	--	--	651
350	136	12	136/199	59	08/81	620	14.7/620	182	315	7.7	652
500	128	16	160/170/187/202 213/244/252/276	60	09/81	810	59.6/810	157	326	7.8	653
300	106	16	--	60	09/81	1,013	44.8/1,013	180	363	7.6	654

Table 1.--Record of wells--Continued

Well location						Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long	Owner	Driller	Year completed	Use			
Cn 156	4102-7729	Don Kramer	New Way Drilling, Inc.	1978	H	700	S	Obf/lmsn
157	4103-7726	Rhine	New Way Drilling, Inc.	1978	H	795	S	Obl/lmsn
159	4103-7726	Glossner	New Way Drilling, Inc.	1979	H	790	S	Obl/lmsn
162	4104-7729	S. Berry	New Way Drilling, Inc.	1978	H	680	S	Obf/lmsn
164	4104-7729	D. Hoffman	New Way Drilling, Inc.	1980	H	635	V	Obl/lmsn
167	4101-7729	R. Crisinger	New Way Drilling, Inc.	1979	H	740	V	Obf/lmsn
169	4104-7728	R. Sementille	New Way Drilling, Inc.	1978	H	640	S	Obf/lmsn
172	4106-7724	T. Smith	New Way Drilling, Inc.	1979	H	940	S	Ocn/lmsn
259	4101-7731	Lamar I. Holiday	PA Drilling Company	1972	C	860	S	Oa/lmsn
276	4101-7719	D. Schrack	New Way Drilling, Inc.	1981	H	1,360	S	Ocn
277	4101-7717	W. Confer	New Way Drilling, Inc.	1981	H	1,335	S	Obl/lmsn
278	4101-7719	A. Kauffman	New Way Drilling, Inc.	1981	H	1,300	S	Obl/lmsn
283	4102-7715	Robert Getty	Gilbert R. Zechman	1978	H	1,340	S	Ocn/lmsn
284	4102-7715	Michael Clymer	New Way Drilling, Inc.	1977	H	1,310	S	Ocn
285	4102-7716	Ken Womeldorf	Gilbert R. Zechman	1977	H	1,230	S	Obf/lmsn
288	4101-7722	T. Jeffries	New Way Drilling, Inc.	1980	H	1,465	S	Or
295	4102-7710	Glen Lupold	New Way Drilling, Inc.	1977	H	1,325	S	Ocn/lmsn
297	4102-7713	Donnell Jeffries	New Way Drilling, Inc.	1977	H	1,265	S	Ocn/lmsn
298	4101-7716	R. Velello	New Way Drilling, Inc.	1980	H	1,370	S	Obl/lmsn
332	4102-7712	Jerry Barner	--	--	H	1,340	V	Ocn/lmsh
333	4101-7713	C. Barner	--	--	U	1,365	S	Ocn/lmsh
334	4102-7712	James Miller	--	--	U	1,290	V	Obl/lmdm
335	4102-7717	Barry Myers	Gilbert R. Zechman	1973	H	1,270	U	Obl/lmdm
336	4101-7718	D. Fisher	New Way Drilling, Inc.	1979	N	1,245	V	Obf/dlmt
337	4101-7718	Amos Fisher	C.S. Garber and Sons	1975	U	1,265	V	Obf/dlmt
338	4102-7715	Jason Breon	Gilbert R. Zechman	1976	H	1,260	S	Obl/lmdm
339	4101-7721	Jason Esh	New Way Drilling, Inc.	1982	N	1,250	U	Ocn/lmsh
340	4101-7716	Ethel Quiggel	--	1964	H	1,320	V	Obl/lmdm
341	4101-7716	John Cella	Gilbert R. Zechman	1971	H	1,300	V	Obf/dlmt
342	4101-7717	Clifford Walizer	New Way Drilling, Inc.	1973	H	1,325	V	Obl/lmdm
343	4101-7720	George Bowes	--	--	H	1,175	V	Obf/dlmt
344	4102-7716	Roy Ovck	Gilbert R. Zechman	--	H	1,300	V	Obl/lmdm
345	4101-7719	Dave Huffman	--	--	U	1,180	V	Obf/dlmt
346	4100-7721	Kramer	C.S. Garber and Sons	1974	U	1,280	V	Obl/lmsh
347	4059-7725	Lydia Stoltzfus	New Way Drilling, Inc.	1981	S	1,380	S	Or/shle
348	4100-7723	Ruth Miller	--	--	U	1,150	V	Obl/lmdm
349	4059-7726	Janet Snyder	New Way Drilling, Inc.	1979	H	1,160	U	Ocn/lmsh
350	4058-7727	Don Stahl	--	--	S	1,100	U	Ocn/lmsh
351	4100-7723	Robert Kustenborder	--	--	U	1,120	V	Obl/lmdm
352	4104-7726	R. Lachat	--	1963	U	675	V	Obf/dlmt
353	4103-7726	E. Force	Wieand Brothers	1975	H	840	V	Obl/lmdm
354	4104-7726	Wilbur Kramer	New Way Drilling, Inc.	1977	H	760	V	Obf/dlmt
355	4105-7724	Daniel King	--	--	N	765	V	Obf/dlmt
356	4104-7729	Ronald Spotts	Frank Copenhaver	1977	H	660	U	Obf/dlmt
357	4104-7727	Wagner	New Way Drilling, Inc.	1978	H	660	U	Obf/dlmt
358	4105-7723	Grace Pletcher	--	--	H	930	V	Ocn/lmdm
359	4105-7724	T. Graine	--	--	N	820	V	Obf/dlmt
360	4104-7727	Ron Parks	Gilbert R. Zechman	1978	H	655	U	Obf/dlmt
361	4102-7727	T. Bechdel	--	--	U	675	V	Obf/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (μS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
200	30	6	86/186	78	07/78	4	0.03/4	188	325	8.0	156 Cn
160	65	6	140	70	07/78	30	.33/30	154	270	--	157
290	70	6	160/284	140	06/79	60	.40/60	154	280	--	159
140	66	6	100	70	01/78	7	.10/7	408	600	--	162
60	33	6	36/48	20	08/80	60	1.5/60	--	--	--	164
100	77	6	80/96	40	10/79	60	1.00/60	307	600	7.2	167
140	21	6	80/120	60	04/78	15	.18/15	290	520	8.2	169
400	21	6	35/194	30	07/79	--	.01/--	357	520	8.0	172
250	103	6	79/126/157/204	65	09/72	--	6.9/83	298	106	7.6	259
240	24	6	50/81/153	19	06/81	12	.06/12	--	--	--	276
160	120	6	152	41	06/81	8	.09/8	188	260	8.0	277
130	100	6	115	40	01/81	45	.50/45	--	--	--	278
201	82	6	95/180	77	06/81	10	--	171	260	7.7	283
260	22	6	120	87	06/77	4	.02/4	291	500	7.3	284
201	120	6	174/197	58	06/81	10	--	291	580	7.5	285
60	23	6	40	2	06/81	15	.50/15	103	220	7.5	288
40	4	6	40	10	06/77	60	2.0/60	--	--	--	295
320	105	6	220/305	130	02/77	30	.16/30	188	310	7.6	297
100	41	6	--	70	05/80	60	2.0/60	137	260	--	298
--	--	--	--	7	07/84	--	--	154	285	--	332
32	--	--	--	3	07/84	--	--	34	70	--	333
--	--	--	--	63	07/84	--	--	--	--	--	334
231	39	6	115/140/212/221	56	07/84	50	--	205	380	7.3	335
120	42	6	94/107	51	07/84	--	.46/30	205	375	7.0	336
135	127	6	80/130	17	07/84	30	.50/30	--	--	--	337
176	124	6	--	52	07/84	30	--	205	370	--	338
275	174	6	189/260	43	07/84	12	.01/12	171	340	7.2	339
150	130	6	--	--	--	10	--	137	239	--	340
207	176	6	130/180/195	84	07/84	30	--	205	295	7.4	341
160	80	6	--	42	07/84	8	--	68	115	7.3	342
--	--	--	--	10	07/84	--	--	120	255	7.3	343
222	56	6	200	65	07/84	42	--	205	760	--	344
18	--	--	--	9	07/84	--	--	--	--	--	345
320	142	6	315	152	07/84	60	.36/60	--	--	--	346
60	33	6	54	24	07/84	60	2.0/60	--	--	--	347
9	--	--	--	8	07/84	--	--	--	--	--	348
80	47	6	60	5	07/84	15	.20/15	137	235	7.3	349
--	--	--	--	59	07/84	--	--	--	108	8.0	350
--	--	--	--	12	07/84	--	--	68	140	7.5	351
152	13	6	--	12	07/84	--	--	--	--	--	352
223	166	6	205	153	07/84	30	--	103	202	7.4	353
400	65	6	398	100	07/84	30	.10/30	274	575	7.8	354
--	--	--	--	99	07/84	--	--	274	740	--	355
78	13	6	42/76	38	07/84	4	.09/4	205	370	--	356
220	22	6	116/204	64	07/84	3	.03/3	239	470	--	357
--	--	--	--	22	07/84	--	--	110	270	--	358
--	--	6	--	107	07/84	--	--	239	660	--	359
90	20	6	--	28	07/84	--	--	188	300	--	360
--	--	--	--	20	07/84	--	--	--	--	--	361

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Cn 362	4102-7728	Park Barner	--	--	H	700	U	Obf/dlmt
363	4104-7726	Ronald Martin	--	1976	N	805	V	Obf/dlmt
364	4103-7726	Larry Rhine	New Way Drilling, Inc.	--	H	770	V	Obl/lmdm
365	4102-7729	C. Brownlee	--	--	N	730	V	Obf/dlmt
366	4103-7729	Dunkle and Grieb, Inc.	--	--	U	840	U	Obf/dlmt
367	4101-7732	Dotter Farm	New Way Drilling, Inc.	1979	H	940	V	Os/lmsn
368	4104-7728	Thomas Mann	--	--	N	720	S	Obf/dlmt
369	4104-7725	John Stevens	--	--	U	740	V	Obf/dlmt
370	4101-7731	Lamar City Manor	Gilbert R. Zechman	1984	C	870	V	Oa/lmsn
371	4101-7731	Forney Bilby	--	--	U	810	V	Oa/lmsn
372	4101-7730	Ken Dishman	--	--	S	745	V	Obf/dlmt
373	4102-7730	Charles Lucan	--	--	U	900	V	On/dlmt
374	4104-7730	Albert Robinson	--	1932	N	655	U	Obl/lmdm
375	4103-7731	Fred Yearick	--	1956	H	740	S	Obf/dlmt
376	4102-7732	Donald Yarrison	Oscar Dearmit	1963	H	920	U	Oa/lmsn
377	4102-7731	Harold Bierly	--	--	H	780	S	Obf/dlmt
378	4102-7732	Ben Stoltzfus	--	--	H	800	S	Obf/dlmt
379	4101-7733	James Muthler	--	1978	N	860	U	Obf/dlmt
380	4100-7731	Alan Bailey	--	--	H	770	V	Obf/dlmt
381	4100-7732	George Ruckel	--	--	U	850	V	Oa/lmsn
Fu 142	3954-7801	G. Gress	Larry G. Walters	1981	H	880	H	Obf/lmsn
143	3952-7800	G. Bivens	Larry G. Walters	1982	H	800	V	Csg/lmsn
144	3953-7801	D. Seiders	Martin W. Shatzer	1982	H	810	V	Orr/lmdm
145	3953-7801	D. Seiders	Martin W. Shatzer	1979	H	820	V	Obf/lmdm
146	3954-7800	W. Kendall	Martin W. Shatzer	1980	H	830	V	Cn/dlmt
147	3952-7759	J. Strait	Larry G. Walters	1982	H	980	S	Obf/lmdm
148	3952-7759	D. McGuade	Larry G. Walters	1979	--	980	S	Obf/lmdm
149	3954-7759	Grant Sanders	Martin W. Shatzer	1980	H	1,020	V	Obf/lmdm
150	3955-7759	K. Richard	Martin W. Shatzer	1978	N	970	S	Orr/lmdm
189	3954-7759	D. Strait	Martin W. Shatzer	1978	H	970	V	Onl/dlmt
190	3953-7759	Great Cove Golf Club	Martin W. Shatzer	1966	C	950	V	Onl/dlmt
191	3953-7759	Great Cove Golf Club	--	1978	C	880	V	Onl/dlmt
192	3953-7759	Great Cove Golf Club	Martin W. Shatzer	1966	I	880	V	Onl/dlmt
193	3954-7759	J. Sipes	Martin W. Shatzer	1983	H	990	V	Orr/lmdm
194	3955-7800	Harry Reeder	--	1976	H	850	V	Onl/dlmt
195	3954-7800	Janice Wolfe	Larry G. Walters	1980	H	880	S	Onl/dlmt
196	3956-7800	H. Branch	Martin W. Shatzer	1978	H	980	S	Ocl/lmsn
197	3957-7758	W.F. Lane	--	1950	H	990	V	Obf/lmdm
198	3957-7758	W. Lane	--	--	U	990	V	Obf
199	3957-7758	P. Mellott	Martin W. Shatzer	1981	H	1,010	V	Obf/lmdm
200	4000-7757	R. Johnston	--	1979	H	980	V	Onl/dlmt
201	3957-7758	PennDOT	--	1967	N	1,020	V	Obf/lmdm
202	3958-7758	Randall Seiders	--	1977	H	1,040	V	Obf/lmdm
203	3958-7758	J. Everts	Larry G. Walters	1980	H	1,130	S	Ocl/lmdm
204	3959-7758	Helen Garlock	--	1968	H	1,010	V	Obf/lmdm
205	3959-7758	Paul Hock	Martin W. Shatzer	1977	S	1,010	V	Obf/lmdm
206	3959-7757	M. Gress	Larry G. Walters	1982	H	1,160	S	Ocl/lmsn
207	3959-7757	J. Armstrong	Martin W. Shatzer	1981	H	1,160	S	Ocl/lmsn
208	3959-7758	Helen Bender	Larry G. Walters	1984	H	1,010	V	Obf/lmdm

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
65	--	6	--	25	07/84	--	--	205	430	--	362 Cn
280	--	6	--	172	08/84	60	--	239	430	--	363
115	--	6	--	47	08/84	--	--	103	240	7.3	364
65	18	6	--	34	08/84	--	--	325	450	--	365
--	--	--	--	6	08/84	--	--	--	--	--	366
280	183	6	270	97	08/84	60	0.39/60	137	270	--	367
--	--	6	--	56	08/84	--	--	239	380	--	368
--	--	--	--	22	08/84	--	--	--	--	--	369
445	110	6	365/443	102	08/84	75	--	--	380	8.0	370
--	--	--	--	8	08/84	--	--	--	--	--	371
--	--	6	--	56	08/84	--	--	222	570	7.1	372
13	--	--	--	5	08/84	--	--	222	790	--	373
55	42	6	--	14	08/84	--	--	--	730	5.0	374
90	--	6	--	32	08/84	--	.96/7.5	--	1,370	5.0	375
400	160	6	--	117	08/84	--	.20/3.6	120	190	7.9	376
--	--	--	--	33	08/84	--	--	--	--	--	377
--	--	--	--	22	08/84	--	--	222	840	--	378
120	20	6	--	14	08/84	10	--	188	400	--	379
--	--	--	--	21	08/84	--	--	188	400	--	380
--	--	--	--	6	08/84	--	--	--	--	--	381
172	20	6	60/160	62	11/84	15	--	256	440	--	142 Fu
215	28	6	28/75/150/195/208	15	11/84	30	--	188	380	--	143
80	80	6	80	23	11/84	60	6.0/60	--	--	--	144
300	--	--	--	28	11/84	--	--	--	--	--	145
122	28	6	80/115	5	06/85	18	.60/18	--	650	3.0	146
320	100	6	160/240/310	66	11/84	12	--	136	330	--	147
88	58	6	75	15	12/79	20	--	--	--	--	148
320	121	6	25/315	120	09/80	18	.23/18	--	--	--	149
290	50	6	280	80	06/78	40	.40/40	--	--	--	150
460	81	6	300/450	70	12/78	8	.03/8	--	--	--	189
215	35	6	70/150/215	40	09/66	--	--	154	329	--	190
400	--	--	--	23	11/84	--	--	--	--	--	191
175	22	6	130/150/175	27	09/66	30	--	--	--	--	192
130	90	6	100	14	05/83	16	.44/16	--	--	--	193
110	27	6	74/82/91/99	20	04/76	13	.28/13	290	800	--	194
275	--	--	--	21	06/85	--	--	273	650	--	195
283	61	6	275	41	06/85	12	.10/12	222	600	--	196
100	--	--	--	--	--	--	--	120	380	--	197
--	--	--	--	44	06/85	--	--	--	--	--	198
265	164	6	260	33	06/85	40	1.00/40	--	--	--	199
--	--	--	--	21	06/85	--	--	274	650	--	200
245	34	6	69/240	37	02/67	26	--	--	--	--	201
323	--	--	58/79/161/245	50	07/77	8	.03/8	137	350	--	202
103	54	6	76/90	21	06/85	25	--	--	490	--	203
40	--	--	--	--	--	--	--	308	690	--	204
50	--	--	--	4	06/85	--	--	103	300	--	205
530	20	6	110/480	25	12/82	3	--	171	380	--	206
263	63	6	180/200/260	50	07/81	12	.40/12	--	--	--	207
115	71	6	105	16	06/85	--	--	273	380	--	208

Table 1.--Record of wells--Continued

Well location						Altitude of land surface	Topo- graphic	Aquifer/
Number	Lat-Long	Owner	Driller	Year completed	Use	(feet)	setting	lithology
Fu 209	3959-7757	Kerlin's	--	1978	H	1,030	V	Obf/lmsn
210	4001-7756	Reed Engler	--	--	H	1,010	V	Obf/lmdm
211	4001-7756	R. McLucas	--	--	H	1,010	V	Obf/lmdm
212	4000-7757	R. McLucas	--	1960	H	1,025	V	Ocl/lmsn
213	3958-7758	Ralph Hielig	Martin W. Shatzer	1973	H	1,100	S	Obf/lmdm
214	3958-7758	Brent Gordon	--	1985	H	1,100	S	Obf/lmdm
215	3950-7801	H. Hendershot	--	1978	H	800	S	Obf/lmdm
216	3949-7802	Leonard Morris	Gerald W. Clark	1980	H	780	S	Obf/lmdm
217	3949-7802	John Hendershot	Martin W. Shatzer	1985	H	780	S	Obf/lmdm
218	3951-7801	D. Richards	--	1975	H	868	V	Onl/dlmt
219	3951-7800	Jack Morton	Gerald W. Clark	1980	H	870	V	Obf/lmdm
220	3951-7759	L. Oechsli	Gerald W. Clark	1978	H	1,090	S	Or/shle
221	3952-7759	L. Oechsli	Gerald W. Clark	1978	H	990	V	Ocl/lmsn
222	3951-7759	R. Richards	Donald W. Graham	1985	H	960	V	Ocl/lmsn
223	3952-7759	Harry Mellott	--	1977	H	920	H	Onl/dlmt
224	3949-7802	K. Harr	--	1974	H	800	S	Obf/dlmt
225	3950-7802	Jackie McQuade	Gerald W. Clark	1980	H	880	S	Onl/dlmt
226	3951-7801	B. Lamont	--	1968	H	750	S	Onl/dlmt
227	3951-7801	Russell Seville	Martin W. Shatzer	1974	H	780	S	Onl/dlmt
228	3954-7800	F. Mellott	Martin W. Shatzer	1976	H	860	V	Ꞓsg/lmsn
Hu 44	4036-7810	Donnie Nichols	--	--	U	860	U	Or/shle
119	4036-7807	Paul Blair	James R. Miller	1974	H	778	V	On
200	4040-7804	Roy Wheland	James R. Miller	1975	H	1,135	S	Os/lmsn
256	4042-7808	Warriors Mark Water	Oscar Dearmit	1965	P	1,380	W	Or
263	4043-7806	W. Buck	Oscar Dearmit	1979	H	1,230	S	Ocl/lmsn
275	4042-7800	D. Campbell	Oscar Dearmit	1979	H	1,115	S	Os/lmsn
343	4031-7750	Jesse Hostetlek	Shoops Well Drilling	1981	H	970	S	Obl/lmsn
344	4030-7751	Janet Huey	Gilbert R. Zechman	1969	U	970	S	Ocn/lmsh
345	4031-7749	Daniel Byler	Shoops Well Drilling	1972	H	920	V	Obf/dlmt
346	4030-7750	Luther Metz	Shoops Well Drilling	1979	H	915	V	Obf/dlmt
347	4028-7752	Donald Goss	--	--	H	910	S	Obl/lmsn
348	4029-7751	Paul Knepp	--	--	H	920	S	Ocn
350	4042-7800	Wayne Colpetzer	Oscar Dearmit	1984	H	1,140	V	Ꞓgl/dlmt
351	4041-7801	Bob Schaffer	--	--	H	1,040	V	Ꞓgm/dlmt
352	4042-7805	Ronald Wrye	--	--	I	1,175	V	Ꞓgl/dlmt
353	4041-7807	Elwood Cox	Oscar Dearmit	1984	H	1,020	V	Ꞓw/lmdm
354	4040-7806	George Lake	Glen R. Weber	--	I	1,020	S	Ꞓph/dlmt
355	4039-7809	Delta Demolition Company	Wieand Brothers	1976	N	1,105	V	Onl/dlmt
356	4037-7806	Brown	Oscar Dearmit	1983	H	870	V	Or/shle
357	4040-7803	H. Wagner	Lee Dearmit	--	H	1,075	V	On/dlmt
358	4036-7807	Earnest Anderson	James R. Miller	1974	H	930	S	Oba/lmdm
359	4039-7806	McCorkel	Lee Dearmit	1964	H	1,140	S	Ꞓgl/dlmt
360	4039-7807	Joe Hicks	--	1932	H	1,000	V	Onl/dlmt
361	4041-7806	Lee Stover	Oscar Dearmit	1979	H	1,010	U	Ꞓgm/dlmt
362	4043-7805	Robert Shaw	Oscar Dearmit	1973	H	1,140	S	Ꞓw/lmdm
363	4042-7809	Robert Nearhoof	Oscar Dearmit	1983	H	1,240	U	Ocl/shle
365	4040-7804	Donald Peterson	Lee Dearmit	1973	H	1,145	V	Os/dlmt
366	4042-7804	Lester Walters	Glen R. Weber	1963	H	1,190	V	Ꞓgm/dlmt
367	4041-7809	A. Shope	Oscar Dearmit	1974	H	1,300	S	Ꞓg/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
208	--	--	--	36	06/85	--	--	120	245	--	209 Fu
--	--	--	--	34	06/85	--	--	120	300	--	210
--	--	--	--	--	--	--	--	137	350	--	211
180	--	--	--	16	06/85	--	--	--	500	--	212
262	82	6	180/262	55	06/85	20	--	120	280	--	213
106	58	6	62/91	38	07/85	12	--	120	340	--	214
120	--	--	--	56	07/85	--	--	290	810	--	215
--	--	--	--	22	07/85	--	--	274	490	--	216
--	--	--	--	30	07/85	--	--	274	460	--	217
125	--	--	--	95	07/85	--	--	308	725	--	218
300	--	--	--	75	07/85	--	--	205	460	--	219
43	21	6	22/27	20	07/85	50	1.7/50	--	310	--	220
264	75	6	48/80/140/248/252	--	--	8	--	--	480	--	221
143	--	--	--	34	07/85	15	--	137	350	--	222
196	29	6	47/163/186	29	07/85	8	0.09/8	308	800	--	223
250	--	--	--	72	07/85	--	--	188	410	--	224
--	--	--	--	100	07/85	--	--	170	430	--	225
50	--	--	--	--	--	--	--	--	540	--	226
--	--	--	--	64	07/85	--	--	256	610	--	227
285	40	6	180/275	100	05/76	50	2.0/50	--	--	--	228
23	--	--	--	14	08/84	--	--	--	--	--	44 Hu
45	20	6	25/30	8	06/80	40	--	171	--	--	119
145	90	6	100/120	--	--	18	--	171	320	--	200
435	23	6	45/140	1	07/65	20	.21/20	--	--	--	256
210	20	6	200	9	07/80	3	--	154	420	8.9	263
125	52	6	115	32	07/80	100	3.9/8.0	137	350	--	275
270	20	6	100/265	14	04/84	15	--	222	500	--	343
197	124	6	160/185	30	04/84	--	--	--	--	--	344
180	--	--	--	15	04/84	--	--	239	490	7.3	345
175	60	6	--	4	04/84	--	--	222	455	--	346
26	--	--	--	4	04/84	--	--	154	340	--	347
--	--	--	--	20	04/84	--	--	85	160	--	348
195	56	6	195	61	06/84	9	.14/7.1	171	660	6.9	350
20	--	--	--	7	06/84	--	--	--	--	--	351
15	--	--	--	5	06/84	--	--	86	370	--	352
60	57	6	--	--	--	--	--	154	555	7.2	353
75	30	6	--	44	06/84	--	--	137	580	--	354
223	102	6	--	109	06/84	--	--	120	415	7.7	355
137	40	6	127	16	06/84	3	--	205	642	--	356
175	--	--	--	20	06/84	--	160/8.0	171	910	--	357
185	67	6	142	94	06/84	--	--	137	560	7.6	358
296	--	--	--	--	--	--	--	120	538	7.5	359
125	--	--	--	53	06/84	--	--	154	733	--	360
95	--	--	--	30	06/84	--	--	34	66	7.8	361
180	43	6	80	67	06/84	2	--	171	555	7.4	362
130	36	6	120	--	06/84	7	--	51	268	7.6	363
140	--	--	--	90	06/84	1	--	--	--	--	365
173	--	--	--	117	06/84	--	--	154	910	7.9	366
300	241	6	300	257	07/84	15	--	120	360	--	367

Table 1.--Record of wells--Continued

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Hu 368	4041-7812	Elmo Richards	Oscar Dearmit	1974	H	1,110	S	Onl/lmdm
369	4041-7811	David Clark	Oscar Dearmit	1983	H	1,080	U	Ocl/lmdm
370	4043-7803	Grant Ellenberge	--	1978	U	1,240	U	Ꞓgm/dlmt
371	4038-7806	L. Myers	Oscar Dearmit	1968	H	880	U	Obf/dlmt
372	4037-7810	Interstate Amiesite	James R. Miller	1984	C	800	V	Ocl/lmdm
373	4034-7808	Lovey Shaffer	James R. Miller	1973	H	840	V	Onl
374	4033-7810	Charles Weko	Donald W. Graham	1983	H	1,010	U	Oba/lmdm
375	4032-7811	William Riley	James R. Miller	1975	I	1,060	S	Ocl/lmdm
376	4035-7808	James Harpster	James R. Miller	1976	H	1,020	U	Oba/lmdm
377	4036-7808	Byron Hawthorne	--	1974	U	1,030	S	Onl/lmdm
378	4042-7801	David Campbell	Oscar Dearmit	1979	N	1,110	V	On/lmsn
379	4041-7803	Evergreen Hunt Club	--	--	R	1,090	U	Ꞓgl/dlmt
380	4040-7805	John Lake	--	--	R	1,055	V	On/dlmt
381	4042-7807	John Peters	--	--	H	1,095	V	Ꞓw/dlmt
382	4043-7806	Samuel Conrad	--	--	O	1,200	S	Oba/lmdm
383	4042-7806	Guy Miller	--	--	U	1,200	U	Ꞓgl/dlmt
384	4044-7806	Frilling	--	--	N	1,240	V	Ocl/lmsh
385	4039-7804	Glenn Houck	Oscar Dearmit	1954	U	1,040	V	Obf/dlmt
386	4036-7809	Wallace Estate	--	--	U	1,025	H	Oba/lmdm
387	4037-7809	Harry Gensimore	--	--	I	1,040	U	Oba/imdm
389	4036-7808	Joseph Kurtz	--	--	H	790	S	Onl/lmsn
390	4032-7809	Jack Edmunds	--	1976	H	800	V	Oba/lmdm
391	4033-7808	Walter Hall	--	--	U	920	F	Or/shle
392	4033-7809	Beckey Donnelly	--	--	N	870	V	Onl/lmsn
393	4033-7810	Gary Shade	Robert N. Eriksen	1984	S	1,015	V	Ocl/lmsh
394	4033-7808	Josephine Owens	--	1960	H	890	U	Oba/lmdm
395	4041-7808	Jessie Marshall	William Houser	--	S	1,160	U	Ꞓw/lmdm
396	4040-7810	Joe Knarr	--	--	H	1,260	U	Ꞓw/lmdm
397	4040-7810	Joe Knarr	Oscar Dearmit	1980	U	1,260	U	Ꞓw/lmdm
398	4041-7807	Elsie Harshberger	Oscar Dearmit	1967	H	1,060	V	Ꞓw/lmdm
399	4039-7808	Rowles	--	1982	H	1,100	V	Ꞓg/dlmt
400	4039-7810	W. Grebe	--	--	H	1,160	V	Ꞓg/dlmt
401	4038-7809	John Strover	Herman E. Bousum	1976	U	1,065	V	Oba/lmdm
402	4038-7808	Edward Newlin	--	--	S	985	V	Onl/lmsn
403	4037-7809	Mike Rugh	--	--	H	1,055	V	Oba/lmdm
404	4038-7809	William Hoover	--	--	U	1,045	V	Onl/lmsn
405	4040-7811	Lois Peck	--	1959	S	1,065	S	Oba/lmdm
406	4039-7809	M. Givler	--	--	H	1,200	U	Ꞓg/dlmt
407	4041-7811	Steve Burns	Martin W. Shatzer	1984	H	1,080	U	Ocl/lmsn
408	4033-7809	Walter Hall	--	--	U	1,030	H	Oba/lmdm
409	4034-7809	Earl Sunderland	--	--	U	930	V	Onl/lmdm
410	4043-7806	Frilling	--	1968	U	1,230	V	Oba
411	4012-7754	W. McElrath	Larry Walters	1981	H	775	V	Ocn/lmsn
412	4011-7752	Kennith Whitsel	--	--	H	885	S	Ocn/lmsn
413	4010-7753	Walter Murphy	--	--	H	905	S	Ocn/lmsn
414	4010-7753	P. Voll	Martin W. Shatzer	1980	H	895	V	Ocn/lmsn
415	4014-7751	Fred Laird	--	--	H	718	V	Ocn/lmsn
416	4014-7751	John Plank	--	--	H	742	S	Ocn/lmsn
417	4014-7751	Leon Riegel	--	--	H	782	S	Ocn/lmsn

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
143	71	6	83/103/130	80	07/84	20	--	222	475	7.4	368 Hu
400	161	6	390	163	07/84	100	--	257	660	7.6	369
--	--	--	--	47	06/84	--	--	120	450	7.5	370
42	36	2	42	15	07/84	25	--	--	--	--	371
65	31	6	58	8	07/84	90	--	257	762	--	372
205	21	6	175/180	22	07/84	17	--	154	505	--	373
410	--	--	--	15	07/84	--	--	239	467	--	374
265	20	--	80/240/248	50	07/84	36	--	222	486	--	375
245	85	6	180/220	104	07/84	2	--	222	860	--	376
305	76	6	145/240/269	186	07/84	4	--	--	--	--	377
125	50	6	--	31	07/84	100	--	171	315	7.3	378
--	--	--	--	42	07/84	--	--	103	160	7.6	379
--	--	--	--	15	07/84	--	--	68	140	7.2	380
--	--	--	--	33	07/84	--	--	171	328	--	381
90	--	--	--	34	07/84	--	3.1/6.7	--	570	--	382
--	--	--	--	2	07/84	--	--	--	--	--	383
--	--	--	--	--	07/84	--	--	137	270	--	384
197	30	6	--	12	07/84	--	--	--	--	--	385
--	--	--	--	32	08/84	--	--	--	--	--	386
22	--	--	--	4	08/84	--	--	222	455	--	387
--	--	--	--	27	08/84	--	--	239	580	6.2	389
124	124	6	--	36	08/84	--	--	222	455	--	390
--	--	--	--	4	08/84	--	--	51	170	--	391
50	--	--	--	25	08/84	--	--	205	611	--	392
--	--	6	--	8	09/84	--	--	188	566	--	393
190	--	6	--	109	09/84	40	5.6/13.4	171	445	--	394
--	--	6	--	82	09/84	--	--	239	728	--	395
260	--	6	--	7	09/84	3	--	171	705	--	396
400	--	6	--	92	09/84	--	--	--	--	--	397
57	--	6	--	17	09/84	--	--	--	450	8.1	398
195	--	6	--	166	09/84	--	--	103	270	8.3	399
137	--	6	--	67	09/84	--	--	103	271	7.9	400
127	127	6	--	118	09/84	--	--	--	--	--	401
--	--	6	--	58	09/84	--	--	205	511	8.0	402
277	--	6	--	68	09/84	--	--	239	610	8.4	403
25	--	--	--	6	09/84	--	--	--	--	--	404
120	--	6	--	100	09/84	--	--	222	595	7.9	405
--	--	--	--	10	09/84	--	--	--	--	--	406
180	--	--	--	159	05/85	--	--	--	--	--	407
155	--	--	--	58	05/85	--	--	--	--	--	408
67	--	--	--	37	04/85	--	--	--	--	--	409
505	--	--	--	6	05/85	--	0.07/5	--	750	--	410
142	42	6	80/130	16	07/86	25	--	137	775	7.5	411
308	--	--	--	41	07/86	--	--	274	600	7.4	412
105	--	--	--	23	07/86	10	--	42	215	7.0	413
180	40	6	170	32	07/86	20	--	137	400	8.0	414
72	--	--	--	24	07/86	--	--	171	545	7.0	415
275	--	--	--	54	07/86	--	--	222	680	7.0	416
--	--	--	--	31	07/86	--	--	124	355	6.2	417

Table 1.--Record of wells--Continued

Well location						Altitude of land	Topo-	
Number	Lat-Long	Owner	Driller	Year completed	Use	surface (feet)	graphic setting	Aquifer/ lithology
Hu 418	4013-7751	Leory Covert	--	--	H	860	S	Ocn/lmsn
419	4011-7753	Marvin Sterhens	--	--	H	802	V	Ocn/lmsn
420	4013-7752	Joseph Myers	--	--	H	718	S	Ocn/lmsn
Mf 149	4036-7744	Union Twp. Municipal Auth.	--	1966	P	805	V	Obl/dlmt
241	4034-7747	D. Byler	Martin W. Shatzer	1978	H	945	S	Obf/lmsn
242	4034-7747	E. Byler	Martin W. Shatzer	1978	H	980	V	Ocn/lmsn
272	4037-7740	J. Kauffman	W.E. Hubler Well Drilling	1978	H	755	V	Obf/lmsn
273	4038-7740	J. Kauffman	W.E. Hubler Well Drilling	1978	H	780	S	Obf/lmsn
275	4039-7741	J. Byler	Shoops Well Drilling	1978	H	900	S	Obf/lmsn
308	4036-7745	Metz Farms, Inc.	W.E. Hubler Well Drilling	1979	S	958	S	Ocn
319	4039-7738	David Peachey	Shoops Well Drilling	1981	H	740	S	Obf
320	4040-7737	Aaron Karnagy	Shoops Well Drilling	1980	H	820	F	Oa/lmsh
321	4040-7737	Mifflin County Airport	Shoops Well Drilling	1979	C	820	F	Obf/lmsn
322	4042-7733	William McNitt	Gilbert R. Zechman	1970	H	750	S	Obl/lmsn
323	4037-7744	Stephen Kanagy	Shoops Well Drilling	1981	H	880	S	Ocn/lmsn
324	4041-7735	R. Hall	Larry G. Walters	1982	H	820	S	Obf/lmsn
325	4039-7736	John Powell	Larry G. Walters	1982	H	740	S	Obl/lmsn
329	4041-7733	L. Boss	Shoops Well Drilling	1978	H	700	S	Obl
334	4038-7739	George Moore	Gilbert R. Zechman	1969	H	820	W	Obf/lmsn
335	4043-7734	William Goss	Gilbert R. Zechman	1969	H	825	S	Or/lmsh
338	4036-7743	Abbotts Dairies	--	1981	N	198	V	Obf
339	4036-7743	Abbotts Dairies	--	1959	N	800	V	Obf
340	4041-7735	L. Himes	--	1978	U	815	W	Obf/dlmt
341	4041-7735	M. Himes	--	1978	U	810	W	Obf/lmdm
342	4041-7735	M. Himes	--	1978	U	815	W	Obf/dlmt
343	4041-7735	L. Himes	--	1978	U	815	W	Obf/dlmt
344	4041-7735	Ira Huron	--	1978	U	800	W	Obf/dlmt
345	4044-7730	Jerry Howe	Gilbert R. Zechman	1968	H	750	S	Ocn/lmsh
346	4040-7737	Mifflin County Airport	Russell R. Brooks	1966	C	820	F	Oa/lmsn
347	4035-7747	Menno Water Company	Gilbert R. Zechman	1969	H	1,200	S	Or/lmsh
349	4036-7742	Moses Zook	Shoops Well Drilling	1981	H	780	V	Obf/lmsn
350	4044-7731	White Cong Church	Gilbert R. Zechman	1967	H	737	V	Ocn/shle
351	4044-7732	Eugene Collins	Gilbert R. Zechman	1968	H	750	W	Ocn/lmsn
353	4042-7731	John Weber	Oscar Dearmit	1972	H	700	S	Ocn/lmsn
354	4043-7733	Blair Fultz	Oscar Dearmit	1967	I	795	S	Obl/dlmt
355	4041-7735	Christ S. Hostetler	Shoops Well Drilling	1980	H	760	V	Obf/dlmt
356	4040-7735	Christ S. Hostetler	Shoops Well Drilling	1980	H	870	S	Obf/shle
357	4043-7735	William Shafranick	Freed and Bell	1972	H	835	V	Or/shle
358	4040-7740	John Hostetler	Oscar Dearmit	1980	H	880	S	Obf/lmsn
359	4038-7739	Dennis Stauffer	--		H	840	F	Obf/lmsn
360	4038-7739	Guy Esh	Gilbert R. Zechman	1970	H	840	S	Obf/lmsn
361	4032-7748	Allensville Mennonite Church	Gilbert R. Zechman	1969	I	930	S	Obf/dlmt
362	4031-7749	Alvin King	Donald W. Graham	1977	H	945	V	Obl/lmsn
363	4035-7744	Sylvanus Peachey	Shoops Well Drilling	1981	H	840	S	Oa/lmdm
364	4034-7744	David Peachey	Shoops Well Drilling	--	H	910	H	Obf/lmsn
365	4032-7748	Ivan Kauffman	--	--	U	980	S	Obl/lmsn
366	4034-7747	Joseph Peachey	--	--	H	1,030	S	Ocn
367	4031-7749	Douglas Zook	Martin W. Shatzer	--	U	990	S	Obl/dlmt

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
--	--	--	--	3	07/86	--	--	188	422	7.0	418 Hu
75	--	--	--	8	07/86	--	--	86	218	8.0	419
--	--	--	--	20	07/86	--	--	105	295	7.0	420
201	32	8	35/75/145/187	28	05/66	--	30/300	295	--	7.4	149 Mf
300	--	--	185/280	87	07/80	--	0.04/8	188	480	7.2	241
300	--	--	--	26	07/80	5	.03/5	--	--	--	242
70	48	6	57	24	07/80	10	.50/10	323	605	--	272
90	33	6	50/80	53	07/80	10	.03/2.0	256	660	--	273
275	21	6	160/255	45	07/80	20	--	374	810	--	275
95	25	6	50/85	1	08/80	25	--	--	--	--	308
200	70	6	195	27	10/83	12	--	376	750	--	319
165	91	6	90/160	40	12/80	25	--	256	520	6.8	320
150	54	6	135	61	11/83	10	5/4.0	256	480	--	321
271	38	6	100/158/260	80	02/70	7	--	--	--	--	322
275	31	6	270	22	06/81	10	--	--	--	--	323
290	98	6	170/260/280	60	11/82	12	--	--	--	--	324
275	114	6	170/210/260	108	10/83	7	--	274	580	6.6	325
100	20	6	80/95	--	--	15	--	307	570	--	329
222	94	6	135/215	50	07/69	35	--	--	--	--	334
247	39	6	90/238/242	3	11/83	30	--	256	495	--	335
200	--	--	--	100	01/51	350	--	--	--	--	338
475	--	--	--	--	--	500	--	--	--	--	339
200	42	6	--	94	09/78	3	--	--	--	--	340
200	42	6	86/163	51	04/83	3	--	--	--	--	341
200	42	6	57/112/150	49	04/83	25	--	--	--	--	342
200	84	6	74	52	04/83	6	--	--	--	--	343
200	42	6	78/162/172/181	41	04/83	12	--	--	--	--	344
172	91	6	101/116/167	40	11/83	30	--	205	260	7.2	345
225	49	6	100/167/220	--	--	15	--	--	--	--	346
346	43	8	88/105	--	--	--	--	--	--	--	347
125	96	6	85/120	31	11/83	30	1.2/10.9	410	875	--	349
72	40	6	45/53/66	9	11/83	8	--	--	--	--	350
172	75	6	90/155/162	--	--	12	--	--	--	--	351
126	41	6	95/115	27	11/83	6	.15/6	239	500	--	353
180	20	6	147/170/175	100	11/83	20	--	308	675	--	354
125	21	6	123	79	11/83	10	--	308	580	--	355
210	75	6	207	--	--	10	--	--	--	--	356
110	33	6	38/68/97	36	11/83	25	.28/25	205	450	--	357
400	56	6	125	54	11/83	3	--	--	--	--	358
123	--	--	--	89	11/83	--	--	--	--	--	359
147	41	6	80/140	--	--	--	--	--	--	--	360
297	40	6	90/117/136	9	04/84	3	--	342	750	--	361
200	--	--	--	50	04/84	--	--	222	500	--	362
275	30	6	130/270	48	04/84	15	--	360	750	7.6	363
285	--	--	--	46	04/84	--	--	--	--	--	364
34	--	--	--	9	04/84	--	--	--	--	--	365
30	--	--	--	17	04/84	--	--	--	--	--	366
--	--	--	--	39	04/84	--	.19/6	256	865	6.9	367

Table 1.--Record of wells--Continued

Well location Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Mf 368	4033-7745	Alvin Hostetler	--	--	U	930	S	Ocn/lmsn
369	4040-7738	Edward G. Miller	--	--	S	805	W	Obf/dlmt
370	4039-7739	Edward G. Miller	--	--	U	820	S	Oa/lmdm
371	4038-7740	Mahlon Peachey	W.E. Hubler Well Drilling	1980	H	880	S	Oa/lmdm
372	4038-7741	Aaron Kanagy	Gilbert R. Zechman	1972	H	860	H	Oa/lmdm
373	4034-7745	Willard Peachey	Shoops Well Drilling	--	S	855	S	Oa/lmdm
374	4035-7745	Kennith Kauffman	Freed and Bell	1968	H	880	S	Obf/dlmt
375	4035-7742	Samuel Peight	Gilbert R. Zechman	1970	H	800	V	Obf/dlmt
376	4037-7741	Joseph Peight	Gilbert R. Zechman	1972	H	830	S	Oa/lmdm
377	4036-7742	Valley View Church	Gilbert R. Zechman	1972	I	860	S	Oa/lmdm
378	4039-7741	Eugene Brubaker	Gilbert R. Zechman	1972	S	840	S	Oa/lmdm
379	4036-7741	J. Glick	--	1971	H	820	S	Oa/lmdm
380	4037-7742	Paul Smoker	Gilbert R. Zechman	1984	S	845	W	Obf/lmsn
381	4037-7742	Michael Smoker	Shoops Well Drilling	1977	H	850	S	Obf/lmdm
383	4042-7736	M. Hostetler	W.E. Hubler Well Drilling	1982	H	900	S	Or/shle
384	4042-7736	Leroy Kauffman	Shoops Well Drilling	1974	H	840	S	Ocn/lmsn
385	4041-7737	Darvin Yoder	Howard Boyd	1971	H	760	S	Obf/dlmt
386	4037-7742	John Renno	--	1977	H	880	S	Obf/dlmt
387	4038-7742	Mark Yoder	--	--	U	860	H	Obf/dlmt
388	4044-7730	Treaster	Shoops Well Drilling	1980	H	840	S	Ocn/lmsn
389	4043-7733	William McNitt	--	--	S	790	S	Obf/dlmt
390	4043-7732	Howard J. Goss	Howard Boyd	1968	H	760	S	Obl/lmsn
391	4045-7729	William Leister	Shoops Well Drilling	1977	H	860	H	Ocn/lmsn
392	4032-7747	James Zook	Shoops Well Drilling	1982	H	1,010	S	Ocn/shle
393	4033-7748	Jacob Kanagy	Howard Boyd	1984	H	980	S	Ocn/lmsn
394	4036-7744	David Byler	--	--	S	865	S	Obl/lmsn
395	4045-7731	Leonard Aurand	Shoops Well Drilling	1981	H	775	V	Or/shle
396	4035-7746	Yoder Bros.	Shoops Well Drilling	1972	C	900	W	Or/shle
397	4039-7737	Daniel Swarey	R.R. Hornberger	1967	H	805	U	Obf/dlmt
398	4035-7746	Kore Peachey	Shoops Well Drilling	1977	S	950	S	Obl/lmsn

Table 1.--Record of wells--Continued

Well depth below land surface (feet)	Casing		Depths to water-bearing zones (feet)	Static water level		Reported yield (gal/min)	Specific capacity/ Rate	Hardness (mg/L)	Specific conductance (µS/cm)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
152	--	--	--	14	04/84	--	--	--	--	--	368 Mf
--	--	--	--	36	04/84	--	--	308	660	--	369
89	--	--	--	64	04/84	--	--	--	--	--	370
245	--	--	--	65	04/84	8	--	359	850	7.4	371
--	--	--	--	55	04/84	--	--	290	705	--	372
150	20	6	80/145	16	04/84	20	--	410	745	--	373
72	27	6	40/65	16	07/68	40	--	--	--	--	374
122	3	6	47/80/110	18	04/84	9	--	290	560	--	375
276	60	6	65/260	80	06/72	--	--	--	--	--	376
276	125	6	175/265/272	50	07/72	12	--	--	--	--	377
201	133	6	140/197	60	07/72	--	--	140	790	--	378
200	--	--	--	27	04/84	--	--	--	--	--	379
147	40	6	70/130	60	06/69	--	--	--	--	--	380
150	--	--	--	51	04/84	--	--	--	--	--	381
170	20	6	120/150	69	04/84	20	0.40/20	137	315	--	383
--	--	--	--	67	04/84	--	--	239	535	--	384
80	--	--	--	13	04/84	--	--	342	630	--	385
180	--	--	--	70	04/84	--	--	222	465	--	386
192	--	--	--	64	--	--	--	--	--	--	387
--	--	--	--	99	05/84	--	--	256	500	--	388
120	--	--	--	103	05/84	--	--	375	745	--	389
147	23	6	147	42	05/84	--	--	256	570	--	390
230	20	6	175	129	05/84	--	--	274	545	--	391
200	--	--	--	16	05/84	--	--	154	310	--	392
370	32	6	--	99	05/84	4	--	85	280	--	393
185	--	--	--	46	05/84	--	--	--	845	6.9	394
257	10	6	--	4	05/84	--	--	68	320	--	395
130	--	--	--	3	05/84	40	--	--	--	--	396
190	60	6	187	54	05/84	15	.20/15	--	--	--	397
360	20	6	120	32	05/84	3	--	393	135	--	398

Table 2.--Record of springs

[Spring number: A serial number assigned at the time the spring was first visited. Many small springs for which miscellaneous information is available are omitted from this table; Location number: Degrees, minutes, and seconds of latitude and longitude, respectively; Use: H, domestic; I, irrigation; N, industrial; P, public supply; U, unused; Z, fish hatchery; T, institution; Discharge: M, measured; E, estimated; R, reported; given in gallons per minute (gal/min); Conductance: given in microsiemens per centimeter, at 25 degrees Celsius (µS/cm at 25°C); Hardness: given as $CaCO_3$ in milligrams per liter (mg/L); °, degrees; --, no data]

Spring number	Location number Lat.-Long.	Spring name (owner)	Altitude of land surface (feet)	Geologic unit(s)	Discharge (gal/min)	Date measured or reported	Use	Temperature (°C)	Specific Conductance (µS/cm at 25°C)	Hardness (mg/L)	Remarks
				Bedford County							
3	400130-0782629	Bubbling Spring	1,120	Bellefonte Formation	100E	09-30-33	H	11	--	255	Two openings; chemical analysis
24	401015-0782410	(Ferry, R.)	1,220	Nittany and Larke Formations, undivided	258M	07-31-85	U	11	450	--	--
26	401010-0782509	(Beach, R.)	1,260	Nittany and Larke Formations, undivided	1,010M	07-31-85	U	12	370	182	Several springs in area
27	401307-0782428	Maria Spring	1,290	Gatesburg Formation	653M	08-01-85	U	10.5	315	155	--
28	395514-0783022		1,130	Bellefonte Formation	263M	08-05-85	U	--	--	--	--
				Blair County							
12	402730-0781210	Big Springs	900	Gatesburg Formation	3,710M	11-10-71	N	11	265	122	Chemical analysis
17	401959-0782404	Roaring Spring	1,200	Nittany and Larke Formations, undivided	4,280M	11-10-71	N	10	350	157	Chemical analysis
20	402511-0781618	(Pa. Fish Comm.)	1,100	Bellefonte and Axemann Formations, undivided	1,410M	11-10-71	H	10	435	215	Four openings; chemical analysis
21	403621-0781218	Arch Spring	900	Coburn through Loysburg Formations, undivided	13,500M	11-09-71	U	11	238	108	Discharge range, 8,000 to 30,000 gal/min
				Centre County							
1	404808-0775049	Thompson Spring	1,010	Nittany Formation	2,700M	11-09-71	T	10	386	204	Chemical analysis
2	404852-0775016	(O.H. Bathgate Spring)	1,000	Nittany Formation	540M	11-09-71	P	11	--	--	Chemical analysis
3	405300-0773631	Penns Cave Spring	1,160	Coburn through Nealmont Formations, undivided	3,420M	11-15-71	R	10	--	--	Chemical analysis
4	405121-0773431	Rising Spring	1,100	Coburn through Nealmont Formations, undivided	5,400M	11-16-71	P	10	305	137	Chemical analysis
5	405432-0774654	Bellefonte Spring	740	Bellefonte Formation	7,500M	11-11-71	P	11	--	121	Borough records; chemical analysis
11	405145-0774526	Blue Spring	900	Benner through Loysburg Formations, undivided	2,180M	08-13-85	Z	11	450	199	Includes two smaller springs; chemical analysis
14	404221-0775805	Rock Spring	1,160	Bellefonte Formation	333M	08-07-85	H	12	290	134	Issues from cave; chemical analysis

Table 2.--Record of springs--Continued

Spring number	Location number Lat.-Long.	Spring name (owner)	Altitude of land surface (feet)	Geologic unit(s)	Discharge (gal/min)	Date measured or reported	Use	Temperature (°C)	Specific Conductance (µS/cm at 25°C)	Hardness (mg/L)	Remarks
				Centre County--Continued							
16	405248-0774740	Forked Spring	830	Gatesburg Formation	3,930M	11-10-71	Z	11	--	--	Chemical analysis
17	405324-0774537	Axemann Spring	840	Nittany Formation	943M	08-08-85	U	12	600	292	Chemical analysis
18	405105-0774921	Benner Spring	910	Gatesburg Formation, Mines Member	4,080M	11-10-71	N	12	395	167	Chemical analysis
19	405420-0774642	Kelly Spring	765	Nittany Formation	8,600M	11-10-71	N	12	310	198	Partial chemical analysis
23	405241-0772802	Weaver Spring	1,060	Benner through Loysburg Formations, undivided	392M	08-14-85	U	10.5	525	244	Flow records--Penn State University
24	405213-0772716	Coburn Spring	1,030	Benner through Loysburg Formations, undivided	126M	08-15-85	U	11.5	525	273	Flow records--Penn State University
25	405525-0772904	Spring Bank	1,212	Coburn through Nealmont Formations, undivided	580M	06-27-67	U	11	345	152	Flow records--Penn State University
32	404730-0774454	(Bickle, C.)	1,125	Coburn through Nealmont Formations, undivided	2,491M	08-07-85	U	12	475	219	--
				Clinton County							
2	410324-0772811	(Valley Dairy)	660	Bellefonte Formation	2,058M	08-13-85	P	15	290	132	Chemical analysis
3	410504-0772728	Big Springs	620	Bellefonte Formation	1,000E	07-30-34	N	--	--	--	Chemical analysis
7	410002-0773203	Steel Spring	860	Benner through Loysburg Formations, undivided	2,000E	1933	Z	13	--	--	--
8	410059-0773150	(Gribe, C.B.)	790	Bellefonte Formation	1,448M	08-13-85	H	11	--	--	--
12	410258-0773132	Cedar Spring	720	Bellefonte and Axemann Formations, undivided	1,070M	08-12-85	Z	13	275	125	Chemical analysis
14	410312-0773103	Lamey Spring	705	Bellefonte and Axemann Formations, undivided	980M	11-10-71	U	11	300	151	Chemical analysis
15	410317-0773058	Crystal Spring	700	Bellefonte and Axemann Formations, undivided	2,941M	08-12-85	Z	11	298	145	Chemical analysis
16	410322-0773055	McLane Spring	695	Bellefonte and Axemann Formations, undivided	500M	08-12-85	U	10	439	220	Chemical analysis

Table 2.--Record of springs--Continued

Spring number	Location number Lat.-Long.	Spring name (owner)	Altitude of land surface (feet)	Geologic unit(s)	Discharge (gal/min)	Date measured or reported	Use	Temperature (°C)	Specific Conductance (µS/cm at 25°C)	Hardness (mg/L)	Remarks
				<u>Clinton County--Continued</u>							
17	405857-0772800	Ruhl Spring	1,040	Coburn through Nealmont Formations, undivided	5,200M	07-04-44	Z	14	315	137	Chemical analysis
19	410058-0773152	Lamar Spring	790	Bellefonte Formation	1,100M	11-09-71	U	10	356	180	Chemical analysis
21	405938-0772503	(Miller, W.)	1,100	Benner through Loysburg Formations, undivided	1,294M	08-14-85	U	14	350	150	Chemical analysis
22	410342-0772346	(Rote Mutal Water)	1,170	Bellefonte Formation	8M	05-02-62	P	--	--	308	Chemical analysis
24	410145-0771844		1,220	Bellefonte Formation	100E	08-15-85	U	--	--	--	--
				<u>Fulton County</u>							
1	395036-0780205	Big Spring	700	Nittany and Larke Formations, undivided	500E	10-13-33	U	10	--	192	Chemical analysis
				<u>Huntingdon County</u>							
1	403919-0781210	Hundred Spring	880	Gatesburg Formation	940M	08-06-85	N	12	280	141	Many openings
2	404132-0780143	Double Spring	1,040	Gatesburg Formation, Mines Member	413M	08-07-85	H	11	157	155	Chemical analysis
13	403408-0780924	Tippery Cave Spring	900	Nittany and Larke Formations, undivided	220M	08-06-85	U	12	360	179	Chemical analysis
				<u>Mifflin County</u>							
1	403347-0774627	Swarey Spring	840	Bellefonte Formation	1,130M	11-11-71	U	10	434	189	Chemical analysis
2	403933-0773851	Yoder Spring	725	Axemann Formation	1,230M	11-08-71	H	10.5	460	195	Chemical analysis
3	404147-0773336	Mammoth Spring at Alexander Caverns	640	Benner through Loysburg Formations, undivided	14,600M	11-11-71	U	9	215	93	Measured discharge includes 2,900 gal/min entering ground 1,000 to north